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Mariners Weather Log

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Cover: The ROBER BLOUGH pushes through an ice-covered channel on a frigid -10°F January morning. The ice- and snow-covered cargo section blends into the foreground as the ship appears to have been cut in two. Photo by Roger Le Lievre.

The Secretary of Commerce has determined that the publication of this periodical is necessary in the transaction of the public business required by law of this Department. Use of funds for printing this periodical approved by the Director of the Office of Management and Budget through June 30, 1980.

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Mariners Weather Log

A FREQUENT VISITOR TO LAKE ERIE

William S. Richardson
Techniques Development Laboratory
National Weather Service, NOAA
Silver Spring, Md.

During late fall and early winter, Lake Erie is frequently visited by storm surges. These abnormal water levels, which are caused by meteorological disturbances, are most pronounced at the western and eastern ends of the lake (fig. 1). During a storm surge event, the lake level may rise more than 7 ft above normal at one end of the lake. At the other end of the lake, 240 mi away, the lake level may fall 7 ft below normal. These distorted water levels cause flooding, shoreline erosion, ship groundings, and problems in generating hydroelectric power.

The damage caused by large positive and negative surges is greater when these surges occur in phase with long-term and seasonal lake-level fluctuations. For example, the greatest flooding and shoreline erosion takes place when large positive surges occur in the spring, after above-normal precipitation in the Great Lakes Basin. When large negative surges occur during the fall, after below-normal precipitation, ship groundings are more numerous. This article briefly discusses the causes and frequency of these surges.

CAUSES OF STORM SURGES

Lake Erie storm surges are generally associated with the passage of extratropical storms through the Great Lakes area. Winter storms which approach the Great Lakes from the central part of the country can cause strong winds over Lake Erie. When these strong winds blow along the main axis of the lake, storm surges are generated. Strong southwest winds blowing over the lake cause a tilted lake surface--the water

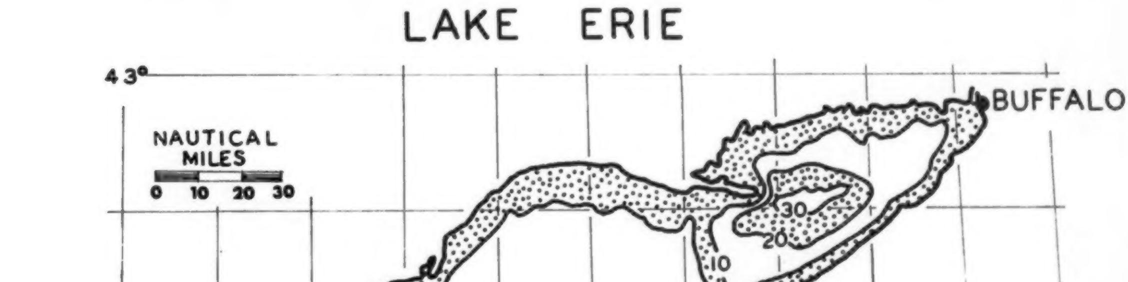
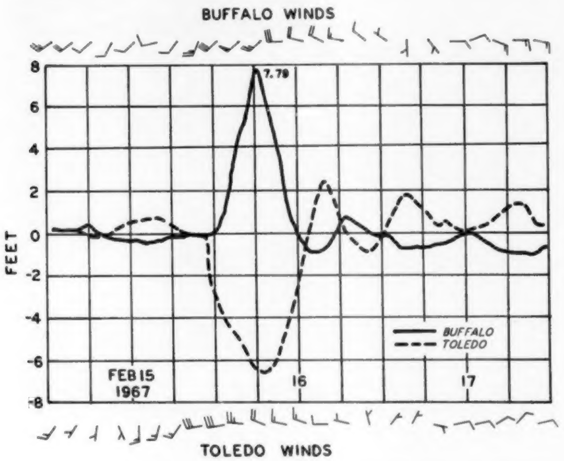


Figure 1.--Configuration of Lake Erie. Depth contours are shown at 10-fathom intervals.

level is elevated in the eastern portion of the lake (Buffalo) and lowered at the western end (Toledo). Storm surge curves, surface wind observations, and surface charts associated with an extreme example of this situation are shown in figure 2. Occasionally, a storm will pass south of Lake Erie causing northeast winds over the lake. When this happens, the water-level slope is reversed with elevated water levels at the Toledo end of the lake. An extreme event of this type is shown in figure 3.



Another type of meteorologically generated lake-level disturbance, which is infrequently observed on the lake, is the type generated by barometric pressure jumps. These pressure jumps may occur with thunderstorms. If the barometric disturbance travels near the speed of the generated water wave, which is controlled by the water depth, significant surges can occur. However, storm surges on Lake Erie are caused primarily by wind stress on the lake surface. The effect of atmospheric pressure, which causes higher water levels in areas of low pressure, is less important. Storm surges are especially pronounced on Lake Erie because of its shallow depth and geographic orientation.

FREQUENCY OF STORM SURGES AT BUFFALO AND TOLEDO

Storm surge is a frequent visitor of Lake Erie. A study of the frequencies of storm surges at Buffalo, N.Y., and Toledo, Ohio, by Pore et al. (1975) revealed that storm surges with magnitudes of 3 ft or greater occurred about five times a year at these locations. Frequencies of storm surges with magnitude of 2 ft or

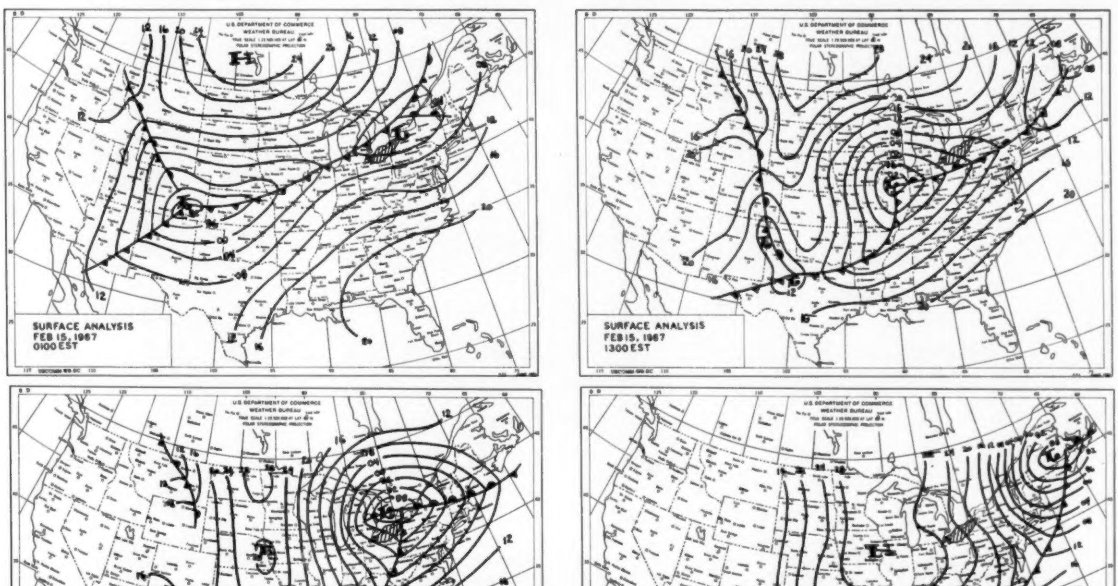
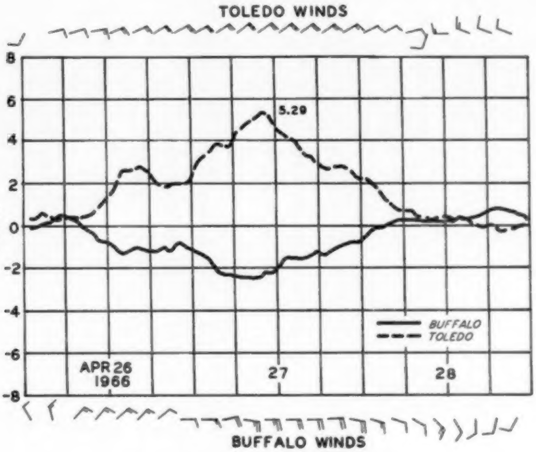


Figure 2.--Storm surge curves, surface wind observations, and surface weather charts associated with the highest storm surge (7.79 ft) at Buffalo for the period 1940 through 1972. The dates are placed at the 1200 EST position on the storm surge graphs. (Pore et al., 1975)

greater at Buffalo and Toledo are shown in figure 4. The upper graph is for Buffalo, while the lower one is for Toledo. High-water cases (positive surges) are shown on the right side of the graph; low-water cases (negative surges) are depicted on the left. Notice that the majority of the surge events are associated with southwest winds (positive surges at Buffalo, negative surges at Toledo).



Pore et al. (1975) also found that 70 percent of the surge heights with magnitudes of 3 ft or greater occurred in late fall and early winter (November, December, and January). Irish and Platzman (1962) attributed the seasonal distribution of storm surges to:

1. seasonal distribution of storm frequencies;
2. the deepening of storms passing over the Great Lakes area caused by the lake acting as a heat source in winter;
3. the effect of thermal instability in the lower atmosphere or wind stress intensification; and
4. the effect of thermal stability within the lake itself.

In late winter (February and early March), the extensive ice cover on Lake Erie is believed to have a restraining effect on the generation of storm surge.

STORM SURGE FORECASTS

The National Weather Service (NWS) is responsible for preparing and issuing storm surge forecasts for Lake Erie. Since 1969, NWS has used a statistically derived forecast technique developed by Richardson and Pore (1969) of the NWS to generate automated

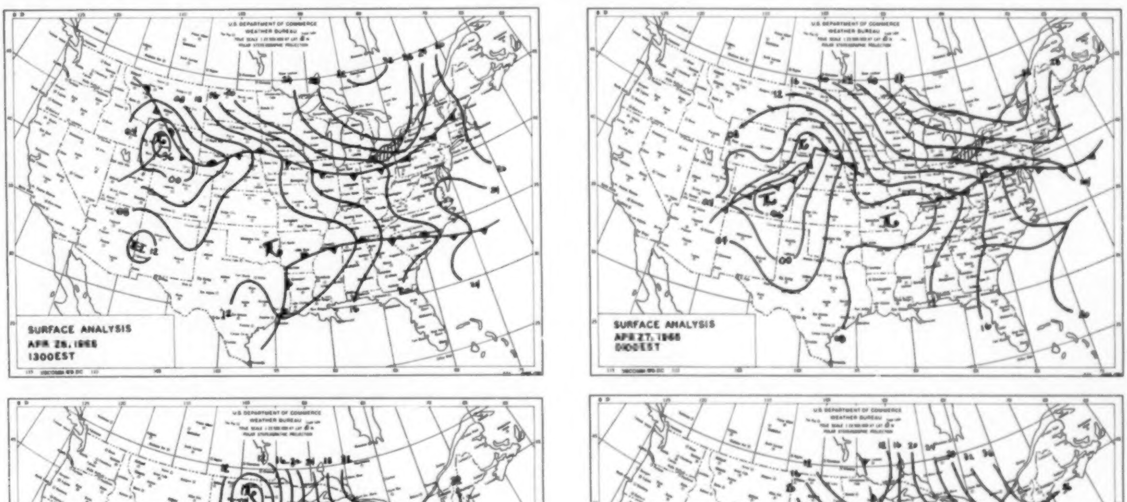


Figure 3.--Storm surge curves, surface wind observations, and surface weather charts associated with the highest storm surge (5.29 ft) at Toledo for the period 1940 through 1972. The dates are placed at the 1200 EST position on the storm surge graphs. (Pore et al., 1975)

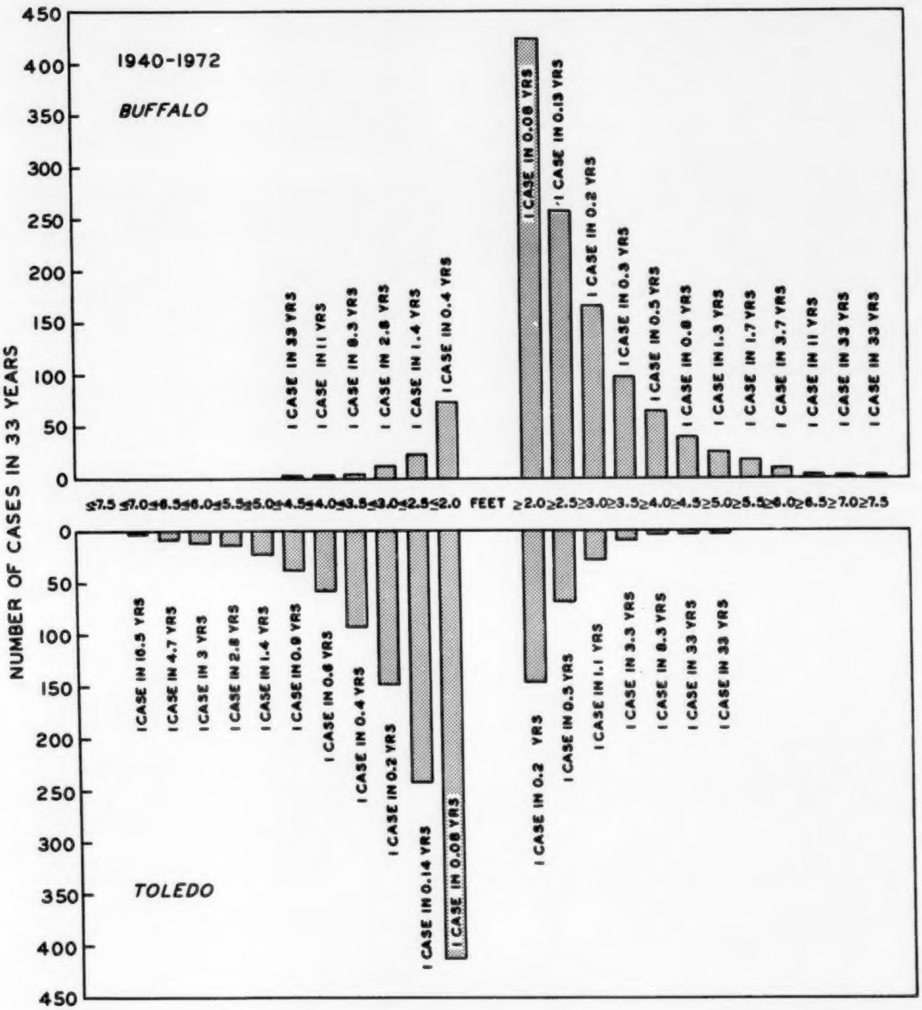


Figure 4.--Frequencies of storm surges with magnitudes of 2 ft or greater at Buffalo and Toledo during the 33-yr period 1940-72. High-water cases are shown on the right side of the graph; low-water cases on the left. (Pore et al., 1975)

storm surge forecast guidance for Buffalo and Toledo. However, this fall, the statistical method will be replaced with a dynamical storm surge model developed by Schwab (1978) of NOAA's Great Lakes Environmental Research Laboratory. Verification of forecasts generated by the statistical and dynamical models indicates that the dynamical model should provide NWS forecast offices with better storm surge forecast guidance than that provided by the statistical method. The dynamical model transforms NWS wind forecasts into storm surge forecasts. These forecasts will aid NWS forecast offices in their task of forecasting the arrival and magnitude of Lake Erie's unwelcome visitor, storm surge.

ACKNOWLEDGMENTS

I would like to thank the National Ocean Survey of NOAA for the lake data used in this study. The author also expresses appreciation to Mary B. Battle for typing the manuscript.

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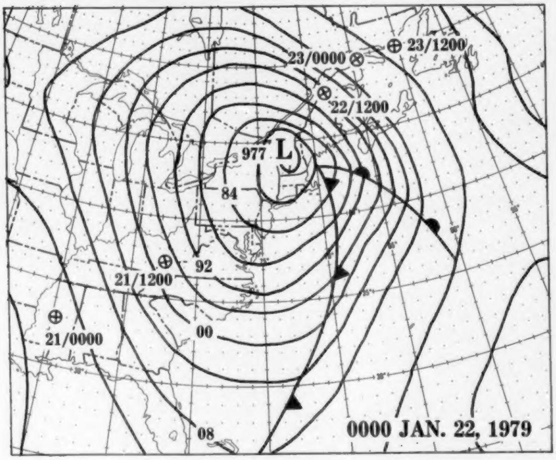
BUOY ADRIFT FROM STATION 41001

Andy Johnson
NOAA Data Buoy Office
NSTL Station, Miss.

On January 23, 1979, at 0334 the NIMBUS-6 satellite fixed the position of a NOAA Data Buoy Office (NDBO) buoy some 35 mi off station. The 12-m diameter buoy had been deployed in 14,000 ft of water at 35°N, 75°W, about 175 mi east of Cape Hatteras, N.C. (fig. 5). It was later discovered that the mooring had parted approximately 10 m below the surface during a storm (fig. 6).

After confirming that the buoy was off station, the U.S. Coast Guard cutter MADRONA was dispatched to recover it on January 26. The MADRONA located the buoy on January 28, some 200 mi northwest of Bermuda; but weather conditions were too rough to allow the ship to take it under tow, so she stood by waiting for winds and seas to abate. The winds were 40 kn and the seas 8 to 10 ft on arrival and increased to 50-

Figure 5.--A 12-m NDBO buoy like the one that broke its mooring and went adrift in a severe storm on January 22, 1979.



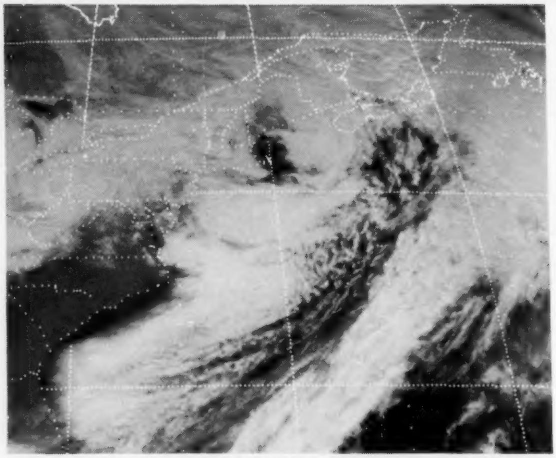


Figure 6.--The storm as it appeared on the 0000 surface analysis on January 22. The circled + shows the later positions of the storm at 12-hr intervals. The satellite image is for 1700 on January 22.

to 60-kn westerly winds with 35-ft seas. During the ship's battle with the storm, she sustained some minor damage and was relieved by the USCGC INGHAM on January 29. All this time the buoy had been reporting meteorological data and position-fixing information to allow NDBO to monitor its status.

Early on the 31st as the MADRONA was returning to Portsmouth, she reported taking on water. The INGHAM suspended its "buoy watch" to assist. The weather remained rough, with winds of 48 kn and 28-ft seas (fig. 7). Repairs were effected on the MADRONA, and the INGHAM returned to the buoy, sustaining minor damage herself.

At 1030 on February 1, the INGHAM was again diverted from the buoy to assist a small vessel which was reported capsized 130 mi east of Bermuda. Shortly after this departure (some time between 1200 and 1500) all communications ceased from the buoy. The last position fix placed it at 34.6°N, 64.4°W, at 0430, and the last frame of meteorological data was transmitted by the buoy at 1200. The next scheduled report from the buoy was due at 1500, but it was never heard. The INGHAM returned to the buoy area on February 5 after assisting the distressed vessel, refueling, and effecting some repairs in Bermuda. She was unable to locate the buoy and discontinued her search on February 6 in the face of further deteriorating weather. The winds were 35 kn and seas 20 ft. It was feared that the 100-ton buoy had capsized, and a "Notice to Mariners" was released.

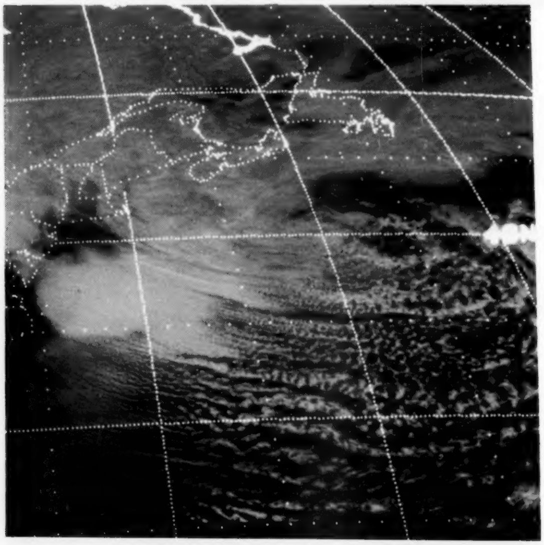


Figure 7.--Both the MADRONA and INGHAM were damaged by this severe winter storm's strong northwesterly winds and waves. They pushed the buoy southeastward.

NDBO received prompt assistance from the U.S. Navy Fleet Numerical Weather Central (FNWC) in Monterey, Calif. FNWC provided daily drift estimates in an effort to predict the course of the inverted buoy. On March 27 a passing merchant vessel sighted the buoy at 29.6°N, 55.3°W, and confirmed it to be capsized. This position was used to update FNWC's drift forces, and 48-hr forecasts (fig. 8) were computed daily and sent to NDBO.

Further sightings of the buoy were made by merchant ships on April 8 by the TRIDENT ROTTERDAM and on the 12th by the BUCHENSTEIN at 26.5°N,

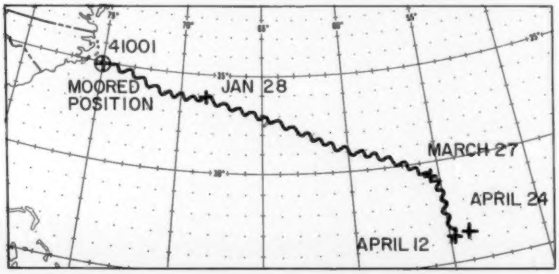


Figure 8.--Approximate track of the buoy.

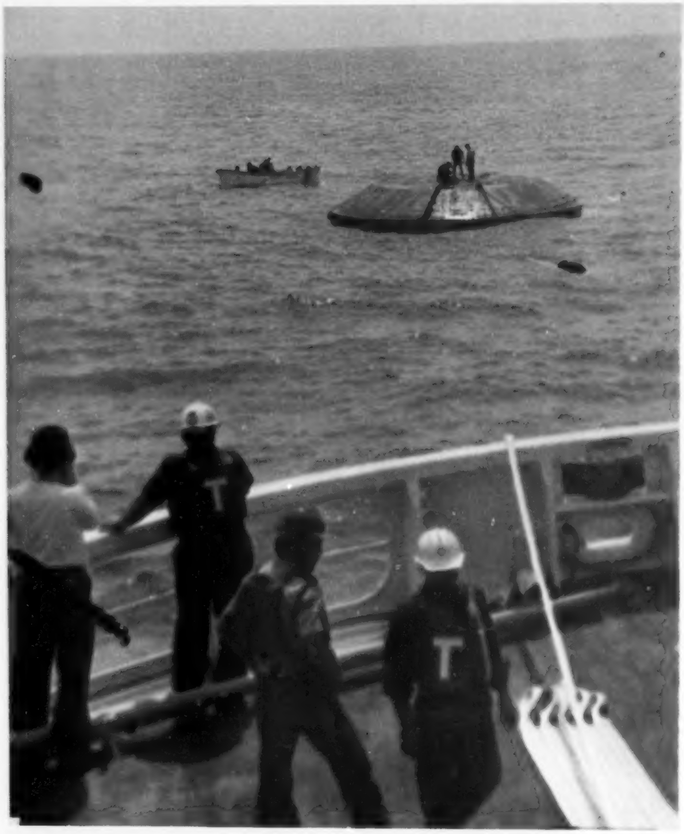


Figure 9.--Crewmen of the USCGC DALLAS get a towline on the capsized buoy. Photo by RM1 Richard E. Morris, U.S. Coast Guard.

54.8°W. On April 24 a Coast Guard C-130 rescue aircraft was dispatched to search for the buoy and it located it at 26.6°N, 54°W, at 1745. Ten hours later the USCGC DALLAS took the buoy in tow at 26.8°N, 54.6°W. On April 27 the USCGC SAGEBRUSH relieved the DALLAS and towed the buoy to Roosevelt Rhodes Naval Station, Puerto Rico, arriving at 1600 on May 2. The buoy was righted the following day and was readied for a tow to Portsmouth, Va. The buoy left Puerto Rico May 30 and arrived in Portsmouth 10 days later with the help of the USCGC BITTERSWEET (fig. 9).

It was found that the mooring line had parted 10 m below the buoy in the upper 3 m of nylon line, just below the upper eye splice. The nylon piece was badly frayed, and although analysis is underway, no definite cause of the mooring failure has yet been determined.

Three other NDBO discus buoys have capsized in severe weather conditions. In 1977, two 10-m buoys capsized in the Gulf of Alaska while moored. (Both of these have since been replaced by 12-m buoys.) A 5-m discus buoy, which was drifting after a mooring failure, capsized in early 1978 in the Atlantic Ocean. Buoy 41001 is the first known capsizing of a 12-m discus hull.

NDBO conducted a study of the environmental conditions associated with all the capsizings. The weather situations were found to be nearly identical in all four cases. In general, strong westerly winds south of deep low-pressure systems occurred for sufficient time intervals that maximum wave energy was found in relatively long periods. Cold troughs with intense convective cells and thunderstorms, evident in surface analyses and satellite images, passed the buoys near the times of the capsizings.

Evidently, extremely strong winds from the squalls, superimposed on an already strong ambient wind field, created high short-period waves. With large amounts of energy in long-period waves present, the additional impetus of high-frequency energy resulted in increased height by superposition and breaking on the crests of longer waves, which precipitated the buoy capsizings. Buoy behavior in other severe weather situations was examined, and it appeared that the combination of conditions present in the capsizing events was not present.

As mentioned above, two of the buoys capsized while moored, and two buoys capsized while in a drifting state after the mooring failures. It is not clear at this time what effects the moorings had on capsizing.

Buoy 14001 was refurbished and redeployed at its original location on September 27, 1979.

Mariners Weather Log

GREAT LAKES ICE SEASON, 1978-79

Daron Boyce
Great Lakes Ice Forecaster
National Weather Service, NOAA
Cleveland, Ohio

The 1978-79 ice season on the Great Lakes was severe for the third year in a row. Many records were broken throughout the Lakes. For the first time in documented history, all of the Great Lakes were nearly frozen over simultaneously in late February. The western lakes took the brunt of the winter with consistently cold weather and frequent very heavy snows. Record amounts of snow were recorded in many areas of the Midwest. Overall, the Lakes region was about 2.5°F colder than normal for the season--slightly milder than the previous year (tables 1 and 2). Commercial cargo tonnages directly assisted were about half those of the previous season (table 3). However, many voyages were completed under very arduous conditions, and vessel damage both to commercial ships and to Coast Guard vessels was at an all-time high.

FALL SEASON

Temperatures over the Great Lakes region were near normal through the summer of 1978. However, the previous cold winter and spring had left most water temperatures below normal, and they were unable to recover during the summer. A colder-than-normal

Table 1.--Departures from normal of Great Lakes air temperatures (°F) for 1978-79 ice season

Month	Lake Superior	Lake Michigan	Lake Huron	Lake Erie	Lake Ontario	Overall
November	-2.3	+0.2	-0.3	+1.3	0	-0.2
December	-4.6	-1.9	+0.4	+2.6	-1.7	-0.3
January	-7.0	-9.1	-4.3	-5.1	-2.8	-5.7
February	-9.2	-9.3	-10.3	-10.1	-10.2	-9.8
March	+0.6	+0.4	+4.0	+5.3	+0.7	+2.2
April	-1.1	-3.5	-1.3	-1.7	-2.0	-1.9
Seasonal Average	-3.9	-3.9	-2.0	-1.3	-2.1	-2.6

Table 2.--Maximum accumulated freezing degree days (FDD) for the 1978-79 season

Station	Maximum accumulated FDD - 1978-79	Date	Normal max. accumulated FDD	Date	1978-79 season versus normal
Duluth	3045	April 10	2281	April 1	+764 (Colder)
Sault Ste. Marie	2209	April 10	1814	April 2	+395 (Colder)
Green Bay	2101	March 28	1422	March 21	+679 (Colder)
Milwaukee	1447	March 16	900	March 12	+547 (Colder)
Muskegon	1190	March 16	666	March 12	+524 (Colder)
Alpena	1591	March 19	1206	March 26	+385 (Colder)
Detroit	946	February 25	585	March 7	+361 (Colder)
Toledo	974	February 25	553	March 5	+421 (Colder)
Cleveland	709	February 20	443	March 5	+266 (Colder)
Buffalo	912	February 20	650	March 12	+262 (Colder)
Rochester	925	February 21	655	March 12	+270 (Colder)

A freezing degree day figure is obtained for each site by subtracting the mean temperature for the day from 32°F. Cumulative totals are compiled with negative daily figures (melting degree days) included.

Table 3.--Summary of icebreaking assistance

Fiscal year	Direct assistance to industry (operation hours)	Cargo tons carried	Value of cargo carried	Number preventative icebreaking missions	Types of cargo
1971	4,080	2,520,152	$ 53,965,269		Cement, coal, general
1972	2,447	2,276,384	61,862,404		Grain, iron ore, limestone
1973	1,341	1,470,995	27,977,811		Petroleum, taconite, grain
1974	3,872	1,681,127	45,640,302		Steel, taconite, wood pulp
1975	2,575	3,662,653	10,933,614	177	Not available
1976	2,775	2,937,083	97,465,465	256	Not available
1977	5,942	4,556,724	125,142,602	47	Taconite, grain, petroleum, steel, coal
1978	6,863	9,507,274	98,982,105	98	Petroleum, taconite, grain, cement, steel
1979	3,990	4,359,953	147,720,000	216	Taconite, petroleum, grain, coal, chemicals, cement

fall was predicted by the National Weather Service in their seasonal forecast at the beginning of September. The forecast was correct, except across Lake Erie and Lake Huron where temperatures averaged about 2°F warmer than normal for the 3 mo.

On September 8 one of several new ships on the Great Lakes made her maiden voyage. The GEMINI, owned by Cleveland Tankers, sailed from Houston, Tex., to Detroit, Mich., with a load of fuel oil. On the 23d, American Steamship's new 635-ft BUFFALO made her maiden trip from Sturgeon Bay to Escanaba for a load of taconite pellets. Three days later, one of the new 1,000 footers placed in service earlier in the year--the BELLE RIVER--loaded the largest cargo of the season when she took on 68,553 tons of coal. And on October 14 the seventh 1,000 footer to sail on the Great Lakes, the GEORGE A. STINSON owned by National Steel, sailed for Lake Superior.

Fall demands for most of the common bulk commodities were the highest in 3 yr. Coal tonnages were down somewhat; but iron ore, taconite, and grain shipments were up. Grain cargoes were up sharply. A strike of about 800 deck officers and marine engineers on October 16 threatened to end shipping on Canadian vessels for the season. However, a quick settlement was reached after a few days of negotiations, and the 130 ships affected continued to sail.

As usual, the number of storms began to increase during the fall. By October the number of ship observations over 30 kn nearly doubled those of the previous month. The strongest storm during October was centered over Lake Winnipeg on the 24th. Winds of 46 kn and 16-ft seas were reported by the MESABI MINER. The CHARLES M. BEEGHLY reported a similar speed on Lake Superior on the 29th.

Unseasonably warm weather started off the month of November. On the 4th Chicago chalked up a new record high for the date with 74°F. The same reading in Detroit the next day broke their record, and in Alpena, Mich., a 76°F high eclipsed theirs by 12°F. On the 8th, a low-pressure area raced across central Canada. The winds with the system were measured at 56 kn on Whitefish Bay by the ROBERT C. STANLEY. Winds over 40 kn were also reported over Lakes Michigan and Huron. At midmonth water temperatures were normal or slightly above as a result of the prolonged mild weather. The first winter storm reached the Great Lakes on the 17th. Up to 11 in of snow fell on southern Minnesota, and 50 to 60 mi/h winds downed trees and wires over a wide area of Michigan. The MARK TWAIN was blown over and sank in Lake St. Clair during the storm.

The first widespread cold outbreak struck at Thanksgiving. Four to six inches of snow fell in Wisconsin, and temperatures were well below normal. The chill continued through the remainder of the month, rapidly removing stored heat from the Lakes. Ice covered 50 percent of Duluth harbor by the 27th, and an "ice watch" was issued in western Lake Superior. Ice also began to appear in the backwaters of the St. Mary's River and Whitefish Bay. At monthend ice had formed in Ashland harbor and the Apostle Islands. Nearly a foot of snow fell in Chicago on December 1 before it changed to freezing rain late in the day.

Very cold weather continued across the western half of the Lakes the first week of December. New snow brought Chicago's total on the ground to 14 in. Detroit collected 2 in on December 9. Below-zero temperatures were observed from western Lake Superior south across Green Bay and western Lake Michigan. The cold weather formed new ice in shallow water areas and thickened ice already in place. In Green Bay the SAM LAUD was the first vessel of the season to require icebreaking assistance. The commercial tug GREEN BAY freed her the next day, but she got stuck again in the harbor channel. The tug BONNIE SELVICK broke her loose on the 11th.

Several groundings were reported in December as the result of high winds or ice. The ERINDALE was aground briefly in the St. Clair cutoff on the 5th, the TROISDOC in the St. Mary's River on the 7th, the PRINDOC near Amherstburg on the 13th, and the CHARLES M. BEEGHLY in Duluth harbor on the 22d.

The Ice Navigation Center in Cleveland opened for the season on December 11. In Saginaw Bay the first direct Coast Guard icebreaking assistance was provided to the NICOLET, PARKER, and EVANS. The CGC BRAMBLE helped the J. BURTON AYERS in Green Bay on the 13th.

Attention was diverted to the St. Lawrence River portion of the Great Lakes system in early December. Opposition to a formal Demonstration Program to extend the navigation season in the River mounted during the fall. Plans for limited experiments through river ice booms were dropped by the Winter Navigation Board after objections were voiced by the State of New York, State conservation officials, environmental groups, and electric power companies.

A major storm moved through the Lakes on December 13. Storm warnings and lakeshore warnings were issued for the Lake Erie area. The storm center was over Lake Winnipeg. The THOMAS WILSON reported 45-kn winds on Lake Huron. In the St. Mary's River the JOHN SHERWIN struck the ice boom in LittleRapids Cut and sustained extensive damage.

EXTENDED SEASON

Milder weather the week before Christmas generally halted major changes in the ice cover, and the only direct assistance provided to commercial ships was in the St. Mary's River. On the 22d the Lime Island ferry line was helped by the CGC NAUGATUCK.

Downstream on the St. Lawrence River, preparations were underway for the traditional closing, which was scheduled for December 20. To prevent a rush of ships attempting to exit the Lakes during the final days, the Seaway set December 6 as the final date salties could transit the Welland Canal upbound, if they planned to leave the Lakes. The deadline for the Montreal-Lake Ontario section was December 15. Ships attempting to leave after the deadline would be fined $20,000 per day (to a maximum of $80,000); however, the fines were later suspended due to regulatory problems and the closing of the Eisenhower Lock on December 20.

On December 20 only four vessels remained in the system, but serious ice problems had developed in the area above the Beauharnois Lock. There was also some last-minute drama when the Panamanian HAND FORTUNE entered the system after the deadline. It appeared she was heading for an unplanned winter on the Lakes, when U.S. Seaway officials would not allow her to transit the locks. However, after a meeting of Seaway officials with representatives of her owners, she was allowed to proceed, but at a cost of $10,000 in lieu of a fine and up to $30,000 in expenses.

Figure 10.--The new Coast Guard cutter KATMAI BAY helps with icebreaking on the Detroit River on its way to its station at Sault Ste. Marie. Wide World Photo.

One of the last ships upbound in the Seaway was the new Coast Guard multipurpose 140-ft vessel KATMAI BAY (fig. 10), the first of five new cutters planned for the Lakes. She had traveled to the Great Lakes all the way from the U.S. West Coast, where the new cutter class was built.

Very cold weather returned to the Lakes the last week of 1978. Heavy snow accompanied the change in some places. In northern Illinois more than a foot of snow was reported. Lighter snow in the upper peninsula of Michigan pushed their ground total above the 3-ft mark. By yearend significant ice was reported in the extreme western end of Lake Superior and the Apostle Islands, most of the St. Mary's River and Green Bay, the southwest corner of Lake Michigan, most of Saginaw Bay, along the U.S. shore from the Bay to Port Sanilac, most of Lake St. Clair, and the western basin of Lake Erie. Coast Guard cutters conducted preventative icebreaking on New Year's weekend in Green Bay, the St. Mary's River, and Duluth. On December 31--the traditional closing date--the NIPICON BAY was the last vessel through the Welland Canal.

January 1979 was a very cold month throughout the Great Lakes, but the worst of the midwinter weather settled on Lake Michigan. There was a significant rise in the number of icebreaking assists starting on January 4. Temperatures averaged from 12° to 18°F below normal for the first week from Lake Erie to Lake Superior. On the morning of January 2 readings hovered at 20° to 25°F below zero in parts of northern Illinois. The next morning it was -6°F at Akron, Ohio. The ice cover formed and expanded rapidly. Green Bay was frozen over, and solid ice covered the Straits of Mackinac from Beaver Island to Bois Blanc as well as the St. Mary's River. Drift ice was observed throughout Whitefish Bay and around the shores of Lakes Huron and Erie. Thicknesses ranged from 8 to 12 in with some ridging from Pelee Passage in western Lake Erie to Port Huron. Twelve to sixteen in-

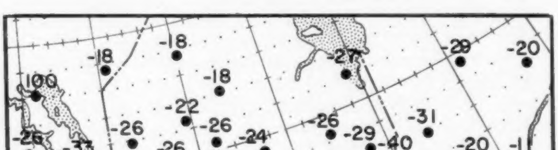


Figure 11.--Minimum temperature chart for January 11, 1979, for the Lakes area.

ches of ice covered Saginaw Bay.

The extreme cold continued through the second week of the month. A major weekend snowstorm added to the misery and icebreaking difficulties. The BENSON FORD was beset in Livingston Channel for 3 days before being freed by the tugs JAMES HANNAH and BARBARA ANN on January 11 (fig. 11). The GEMINI was trapped in ice in Saginaw Bay on the 8th. It took her 3 days to reach the Dow Chemical docks even with the help of the CGC BRAMBLE.

The "monster storm" of the winter roared through the central Great Lakes on the weekend of January 11 to 13. The Pacific storm reorganized over Wyoming, dipped southeastward to Oklahoma, and sped to southeastern Ontario on the 14th, bringing most of its Gulf moisture with it. On the morning of the 11th, the Midwest shivered with readings ranging from -5°F at Cleveland to -16°F at Chicago's O'Hare field to -29°F at Duluth. As the storm traveled northeastward from Oklahoma, light snow started in Chicago about 8 p.m. on the evening of the 12th. Only 1-1/2 in was added to the old snow base of 9 in during the first 6 hr, but soon thereafter it fell at a rate of 1 in per hr for 18 hr. When it finally ended at 2 a.m. on the 14th, 20.7 in of new snow had fallen on Chicago--second only to their 1967 storm fall of 23 in. The 29 in on the ground was an all-time record. It may have been short of the total on the ground during the "Winter of the Deep Snow" in 1830-31, when no total was recorded for Chicago because the U.S. Army weatherman was on maneuvers in Wisconsin that season.

Two major incidents took place on Lake Michigan and nearby Green Bay during the storm. On January 12 the fish tug SAN JOSEPH became stuck in thick ice about 1 mi from Chicago's Oak Street Beach. The crew radioed the Coast Guard that their ship was being slowly crushed by the ice; they did not know their position because of the low visibility. Small search aircraft were unable to launch during the storm, so the Coast Guard ordered its C-130B aircraft, with precision radio direction-finding gear, from Cleveland to overfly the area. The plane routinely flies Side-Looking Airborne Radar (SLAR) ice flights over the Great Lakes each winter. Piloted by Commander Leon Thomas, the tug was located using the SLAR and radio equipment. The crew was rescued from the tug on the 14th by Coast Guard and Chicago Fire Department helicopters. No Coast Guard tugs were available because they had been deployed to Green Bay.

What began as a routine icebreaking mission in Green Bay on January 13 turned into one of the most dramatic events of the winter. The EDWIN H. GOTT, U.S. Steel's new 1,000 footer, left Bay Shipbuilding on her maiden voyage on the 12th under escort of the CGCs ARUNDEL and ACACIA. She reached the open waters of Lake Michigan, and the cutters returned to the Bay to assist the JUPITER, the AMOCO ILLINOIS, and later the WILFRED SYKES. The ARUNDEL became beset in a windrow near Minneapolis Shoal late on the 13th. Strong winds moved the ice and the ship toward the Shoal. Rafted ice ripped through two windows in the Chief Petty Officer's quarters and tore away stantions on her main deck. The ice continued to pile up to the "01 deck," completely covering the stern and causing a 25-degree list (fig. 12). An estimated 20 tons of ice lay on her decks. Fearing the ship's hull was about to crack under the weight and pressure of the ice, the crew abandoned the vessel and walked by spotlight to the ACACIA, which was also beset nearby by this time. The major Great Lakes icebreaker MACKINAW and the SUNDEW as well as a helicopter from Traverse City were diverted to assist, but the winds shifted before they arrived. Northwesterly winds rapidly loosened the ice pressure and the ships were freed. The crew reboarded the ARUNDEL, and she limped to Sturgeon Bay for a complete inspection that revealed about $13,622 in damages.

Figure 12.--The USCGC ARUNDEL is wedged in ice off Rock Island in Lake Michigan. Her 20-man crew, linked together with ropes, walked 300 yd across the ice to the cutter ACACIA, which kept the ARUNDEL illuminated. The ACACIA was also stuck but managed to free herself and the ARUNDEL. Wide World Photo.

Coast Guard vessels were not the only casualties of the storm and ice that week. The BENSON FORD reported $1,000 damage in Lake Erie, the PUTZFRAU $25,000 damage in the Cuyahoga River in Cleveland, and the ADAM E. CORNELIUS $15,000 and the THOMAS PATTON $25,000 in Green Bay. The GEMINI sustained $40,000 damage on a trip in Saginaw Bay on the 15th.

The cold weather and heavy snow continued to build an ice cover. Lake Erie was frozen over, with the exception of an area off Long Point, with 4- to 14-in ice (fig. 13). Heavy brash jammed the Detroit River with 6 to 12 ft of ice. Foot-thick ice covered Lake St. Clair, most of Georgian Bay, Green Bay, and the St. Mary's River. Lakes Huron and Superior were about 35-percent covered, and Lake Michigan was about 20-percent covered. The Straits of Mackinac and Green Bay were locked up with 4 to 14 in of ice. Pressure in the Bay was creating considerable difficulty. The Coast Guard logged 117 direct icebreaking assists and numerous missions for preventative icebreaking during the first half of the month.

The unusually heavy brash ice in the area from the St. Clair River into Lake Erie continued to hamper shipping following the midmonth storm. The Arctic

Figure 13.--This abandoned lighthouse appears locked in Lake Erie ice floes. Wide World Photos.

icebreaker WESTWIND was deployed to the area and relieved many of the problems. The KATMAI BAY arrived at her new homeport of Sault Ste. Marie on the 16th. Along the way she logged her first Great Lakes icebreaking assistance by helping the MESABI MINER. Coast Guard ship casualties in Lake Michigan left them short of active resources for heavy winter icebreaking. The BRAMBLE was moved from the "Coal Shovel" area to Lake Michigan to serve "Oil Can." Canadian Coast Guard resources were also short. The Canadian ship ALOGOWAY was beset in Goderich, Ontario, for 2 weeks. The cutter GRIFFIN and the tug BARBARA ANN assisted her.

Another drama unfolded on the Lakes on Friday, January 20. A Flint, Mich., pilot returning from Boston, Mass., encountered severe icing conditions over Lake Erie and ditched his plane on the ice. Dennis Gravelie, the pilot, attempted to walk to shore to safety, but found that he and his plane were on a large floe. Later that day the signal from his emergency locator transmitter (ELT) was picked up on shore, and the Coast Guard was notified. The Coast Guard launched an HH-52 helicopter from their base north of Detroit, but it was forced back by heavy icing. A Canadian Coast Guard plane arrived early on the morning of January 20. It was relieved by the U.S. Coast Guard SLAR aircraft toward dawn as personnel at the Rescue Coordination Center in Cleveland enlisted the aid of a local civilian trafficopter pilot, Art Fantroy. The helicopter did not have navigational equipment, so the Coast Guard aircraft guided it through the early morning fog to the crash site. At about 9:30 a.m. Fantroy spotted the plane, landed near it, and returned the pilot to shore--some 22 hr after the crash. He landed with only minutes of fuel left. The plane was also rescued by helicopter. Later in the year Fantroy was awarded the Silver Lifesaving Medal, the second highest civilian award.

After 3 weeks of below-normal temperatures, milder weather reached the Midwest and Great Lakes region. The ice cover stabilized or grew slowly until the last few days of the month. The heavy ice already in place continued the need for icebreaking assistance. The Coast Guard logged 106 direct icebreaking assists by the end of the month. On the 30th the CGC NAUGATUCK lost her propeller near DeTour. Corps of Engineers divers recovered the propeller, and it was reunited with the ship at the Sturgeon Bay shipyard. The GEMINI was damaged for the second time in Saginaw Bay on the 28th, and the JUPITER was damaged after transiting Lake Michigan the following day. On the last day of the month major damages resulted when the ARTHUR M. ANDERSON hit the icebreaker WESTWIND from behind near Ashtabula on Lake Erie. The WESTWIND was breaking track when it hit a pressure ridge

Figure 14.--The Coast Guard cutter MACKINAW leads the ENDERS M. VOORHEES through ice near Sault Ste. Marie. Roger Le Lievre photo.

and suddenly stopped. The ANDERSON was unable to change course in time to avoid the icebreaker. Neither vessel took on water; but the bow of the ANDERSON was holed, and her main and forecastle decks were buckled. Damages on the WESTWIND included buckling of her main deck and some smaller gashes.

The milder weather at monthend eased the ice conditions, especially in the Straits and Lake Erie. In both areas, solid ice cover broke loose, and drift ice was the rule in the southern Straits and northern Lake Erie from the islands to Long Point. Ice cover on Lake Superior was greater, however, with the lake frozen over from Isle Royale and the Keweenaw peninsula westward. On Lake Michigan drift ice was reported along the entire western shore and up to Muskegon on the eastern side. On Lake Huron drift ice extended southwest of a line from Alpena to Point Clark. Three- to six-foot ridging was noted in Lake Erie, and 3- to 4-ft hummocking in Saginaw Bay and 6- to 12-ft hummocking in Whitefish Bay.

February was by far the coldest month of the winter. Temperatures averaged nearly 10°F below normal across the Lakes (fig. 14). The coldest area was around Lake Michigan. On the 5th record cold plunged the mercury well below zero. Chicago chalked up a -17°F at Midway Airport. The next morning Toledo managed a record-breaking low of -7°F. The frigid weather continued into the latter part of the week, and Rochester, N. Y., notched a -13°F record low on the 9th. The extensive cold weather rapidly reclosed many of the drift ice areas around the Lakes, and some new ice formed. Shipping dwindled to just a few vessels, and icebreaking became almost a continuous operation in order to move them (fig. 15).

The second week of the month brought more snow to the Great Lakes to accompany the continued chill. New snow at Chicago boosted their season total to 82 in--a new record. Toward the end of the week the thermometer readings at Muskegon, Mich., skidded to a new low of -23°F. Ice on Lake Erie became especially difficult during the first half of February. The ROGER BLOUGH smashed her way to within a few miles of Conneaut harbor near the Ohio-Pennsylvania border, where she became beset in ice on the 8th and was still there a week later. Northerly winds persisted during most of the period, and the ice jammed in 15- to 30-ft ridges. The Coast Guard icebreaker WESTWIND provided relief throughout the period. Finally, on the 16th the winds shifted, and the BLOUGH was able to move the last 300 yd into the main harbor for unloading. Meanwhile, on the St. Clair River the Harsens Island ferry service was ended temporarily by an ice jam near Algonac on February 12.

Damages on commercial vessels continued to mount. The PHILIP R. CLARKE reported damage in Lake Michigan on the 12th. On Valentine's Day the GEMINI reported her third casualty of the season in Saginaw Bay. Her repair bill for ice damage was the highest of the year--a quarter of a million dollars! Ice cover continued to expand and thicken throughout the Lakes. On the 15th the ore docks at Escanaba closed for the season, ending shipping into the Green Bay area.

Figure 15.--The WESTWIND helps two freighters through the ice on Whitefish Bay. Sandusky Register photo.

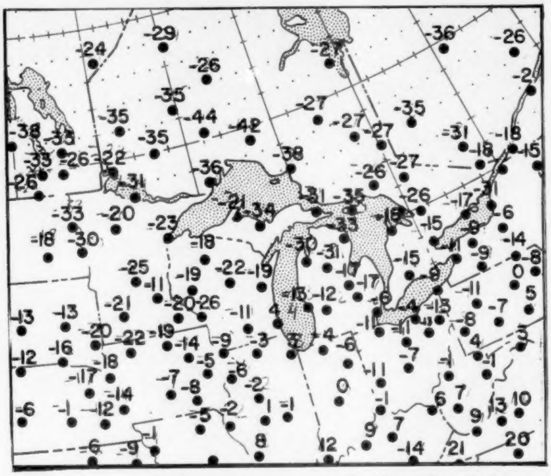


Figure 16.--Minimum temperature chart for February 17.

On the morning of the 17th the entire Great Lakes region was frozen in with below-zero cold. Readings ranged from -38°F on the north shore of Lake Superior to around zero at the southern end of Lake Michigan (fig. 16). Traverse City (-37°F) hit a new all-time February record, while Muskegon (-23°F) and Buffalo (-10°F) set records for the day (fig. 17). The only open waters on the Great Lakes by the end of the week were along the shore in northeastern Lake Huron, along the eastern half of Lake Michigan from near New Buffalo to Pentwater, and in the eastern basin of Lake Superior where ice was still drifting. Over the weekend, the open water on Lake Huron closed up and so did the area on Lake Michigan. Light westerly winds opened new leads along the western side of Lake Michigan and in the southern sections of Lake Superior. For the first time in recent documented history, all of the Lakes were nearly 100 percent frozen over at the same time (fig. 18). Even Lake Ontario, which rarely is covered by more than a few miles of ice around the edges, was more than 90-percent covered.

Late in the week a convoy of ships departed Sault Ste. Marie across Lake Superior for Two Harbors. Ice was tough all the way across the lake. Thicknesses ranged from 8 in to 2 ft. The CGC MESQUITE and the icebreaker MACKINAW worked directly with the convoy, which consisted of the EDWIN GOTT, JOHN MUNSON, PHILIP CLARKE, and the CASON CALLAWAY. They finally arrived in the Two Harbors area on the 21st with "a damage list long enough to give any vessel manager nightmares" according to Lake Log Chips. The GOTT was upbound on her way to load her first cargo. She lost one of her twin rudders and damaged her side tank. Costs were estimated at $150,000. The CLARKE sustained mechanical damage to a steering engine, the CALLAWAY suffered hull damage, and the MUNSON was delayed at the docks because of the damaged vessels. The tug EDNA G. lost a propeller blade while doing some preventative icebreaking in the harbor area. The delays and damaged ships resulted in a temporary pellet shortage at plants between Gary and Indiana harbor.

On Lake Michigan car ferry operations were severely curtailed by the heavy ice. The SPARTAN got stuck

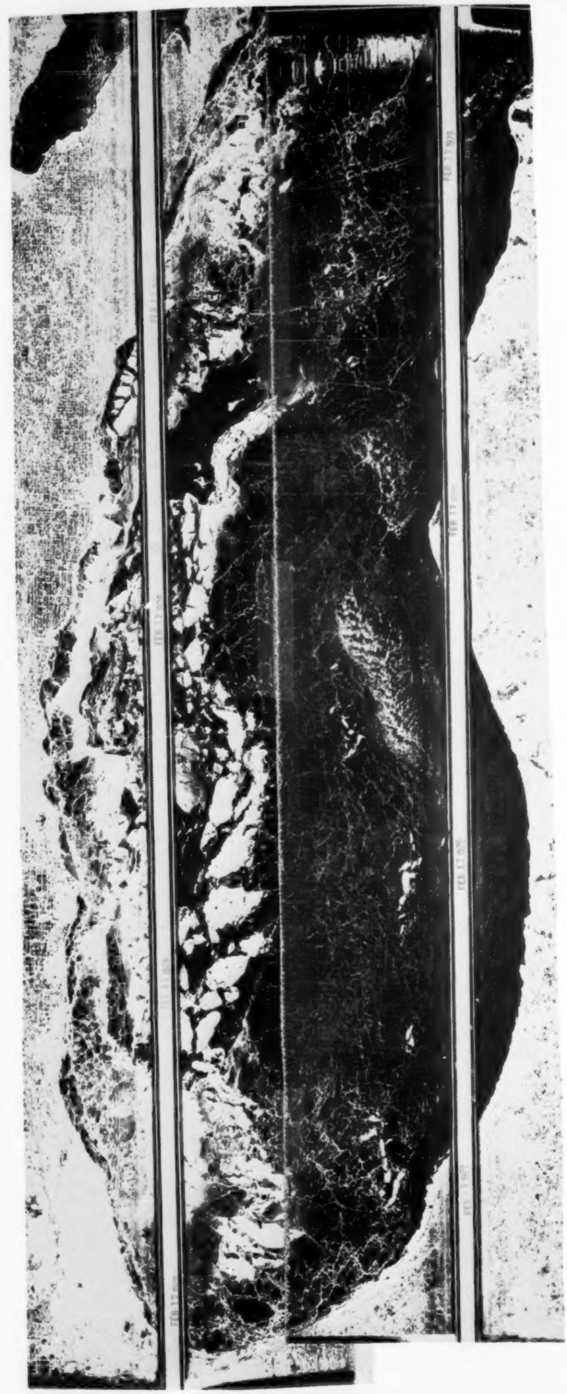


Figure 17.--This SLAR image of Lake Michigan for February 17, 1979, is a composite of two tracks, one along the west shore and the other along the east shore. This data was used to prepare the ice chart on the facing page.

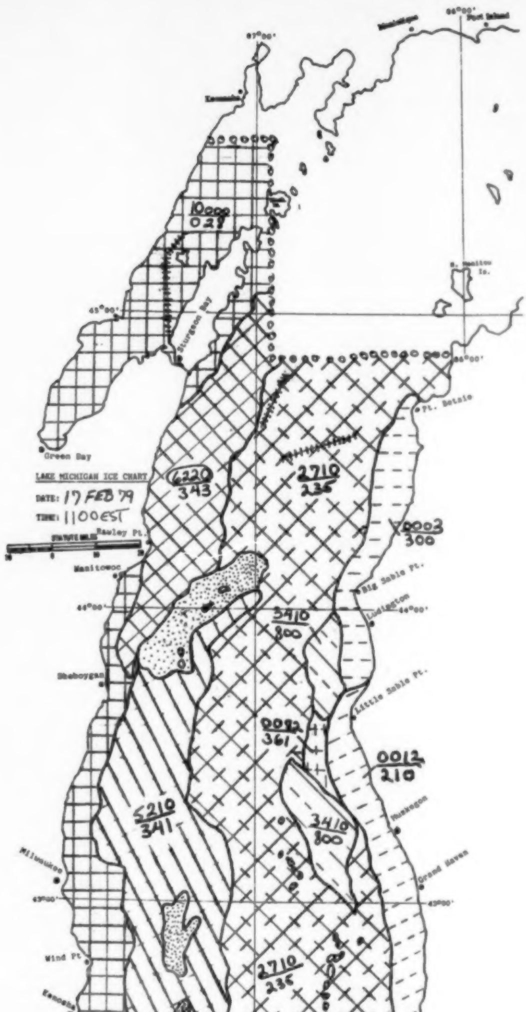
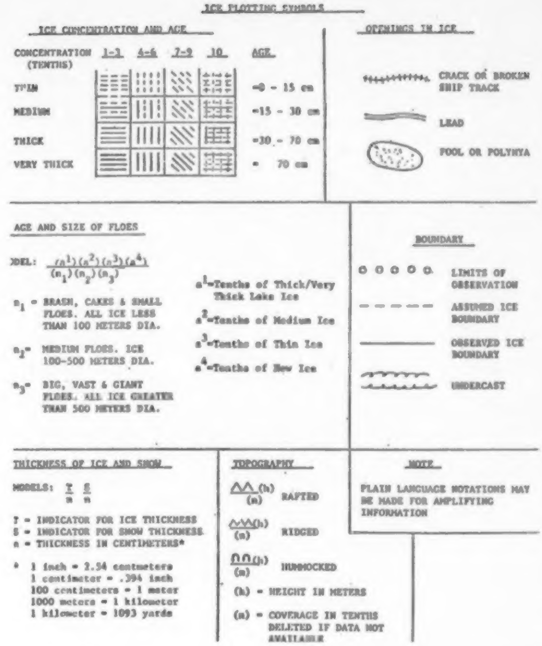


Figure 17a.--The ice chart for February 17 that was transmitted over facsimile. The legend is shown in the upper right-hand corner of the page.

about 1 mi from the entrance to Milwaukee harbor on the 18th. The BADGER freed her a few hours later. The EDWARD RYERSON was leaving Milwaukee and tried to help, but she got stuck also. The RYERSON



was kept busy moving steel from the southern end of the Lake to Milwaukee--a task normally left for the railroads, but heavy snows had tied up their operations. On February 20 the VIKING was beset in ice in the entrance to Frankfort, trapping the CITY OF MILWAUKEE in port. The ACACIA and RARITAN helped both of them.

Much milder weather and rain pushed into the Lakes region from the south during the last week of February. Melting ice and snow broke ice jams on many of the

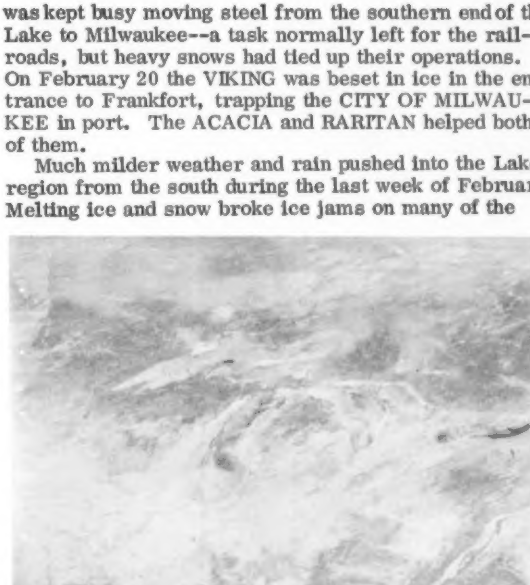


Figure 18.--A satellite image of the Great Lakes Basin on February 19 showing the Lakes nearly 100-percent ice covered.

rivers within the Lower Lakes watershed. The first seasonal flood relief operations began along the Ohio shoreline on the 25th. The Coast Guard dispatched the KAW and MARIPOSA to assist. Both ships reported minimal progress due to gale winds and heavy brash ice and spent several days in the area before reaching the inner harbors of Lorain and Cleveland.

By monthend the warmer weather had melted some of the ice cover in the Lower Lakes. Lake Superior remained nearly frozen over. Drift ice was reported in the eastern third of Lake Huron and within about 25 mi of the Canadian shore of Lake Erie from the Islands to Long Point. The eastern shore of Lake Michigan also was open except for harbors and some fast ice along the immediate shore.

SPRING OPENING

The warm weather carried into the first week of March, bringing thoughts of spring weather to many shippers. The National Weather Service seasonal outlook for spring (March through May) indicated above-normal temperatures for most of the Lakes region. On March 2, the first spring opening was noted as the annual "Coal Shovel" runs from the docks at Toledo to the power companies in Detroit started operations. The HENRY FORD II opened the season with the help of the tug WILLIAM A. WHITNEY. The next day the icebreaker MACKINAW, which had been pounding ice for ships all winter, entered Sturgeon Bay Shipyard for repairs to her port propeller shaft. Most of the damage ($182,000) was sustained on Lake Superior convoy escort in late February.

The warmer weather lasted until midmonth, and then a period of alternating warm and cold spells ensued. On Monday, March 12, the temperatures soared to 53°F at Alpena and 52°F at Chicago--both records for this date. The day before a low of -3°F undercut the record for Chicago. By midmonth the ice had retreated in many areas (fig. 19). The most noticeable changes occurred on Lake Michigan, where the only solid ice remaining was fast to the nearshore in the southeast portions. Drift ice covered the eastern third to eastern half from Pentwater into the Straits. Lake Superior was mostly ice covered, although drift-ice areas were observed east of the Keweenaw and from Isle Royale northeast to the Canadian shore and southeast to near Whitefish Bay. Fast ice remained around the rims of Lake Huron with drift ice over the northeastern two-thirds. Open water was observed in the southwestern third outside of Saginaw Bay and in parts of Georgian Bay. Solid ice covered Lake Erie only in parts of the western basin and in the eastern end from the New York-Pennsylvania border.

In the damage department, the ROGER BLOUGH sustained damage on Lake Superior as did the CASON CALLAWAY. The NAUGATUCK spent 3 weeks in the shipyard for shaft work after she lost her propeller again. Damages totaled $26,000. Similar damages were reported by the OJIBWA to repair her port main engine.

Temperatures were well above normal in the third week of March. Muskegon had a new record of 68°F for March 22. Ice cover on Lake Superior diminished significantly for the first time. The only 100-percent coverage remaining extended from Duluth through the Apostle Islands, behind Isle Royale, and in the southern and eastern bays and harbors. Lake Michigan ice was limited to drift floes in the northern third and a long patch in the southeast corner. The Straits of Macinac, Saginaw and Green Bays, the north channel, and extreme eastern Lake Erie were the other areas still with 100-percent coverage. Considerable drift ice remained on Lakes Erie and Huron. In spite of eased conditions, the IMPERIAL ST. CLAIR returned to the Soo after an unsuccessful try for Thunder Bay, Ontario, without an icebreaker.

Cooler-than-normal weather dominated the western half of the Lakes region in the last week of the month,

Figure 19.--On March 15, less than a month after the solid freeze over, only Lakes Erie and Superior have extensive ice cover.

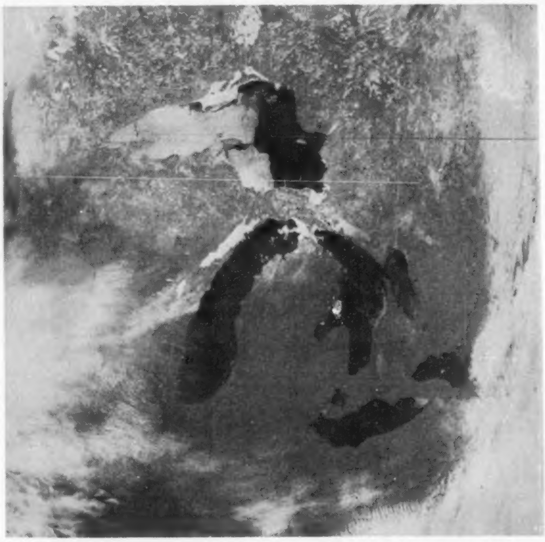


Figure 20.--The ice disappeared rapidly and by April 3 only western Lake Superior has significant open-water ice.

while milder weather continued in the remaining sections. On March 27 the LEON FRASER punched a hole in her bow on a trip across Lake Michigan to Escanaba. On the 28th the H. M. GRIFFITH was the first upbound ship to transit the Welland Canal for the year. The first downbound ship was the TADOUSSAC. The ice was not the only thing that was melting. The record snow cover in the Midwest was also reacting to the warm weather, and numerous floods were reported in parts of Illinois, Indiana, and Michigan. Warmer weather brought open water to eastern Lake Superior, but new ice formed in the western end. Only some drift ice was still around in northern Lake Michigan, the northeastern third of Lake Huron, and in the U. S. waters of Lake Erie from Fairport harbor to Dunkirk and a solid ice plug from there into Buffalo. Saginaw, Green Bay, and most of Whitefish Bay remained ice covered at monthend.

The St. Lawrence Seaway season began normally on April 2 (fig. 20). The Finnish ship PUHOS was the first foreign boat into the system. She called at the Port of Toledo on April 5--a new record early date. The annual clash between warm and cold air masses continued over the Lakes during early April. An early spring storm swept through the southern lakes with a cold front on April 5 and 6. At Milwaukee the CLARENCE B. RANDALL broke loose from her moorings and wedged herself against a dock at Jones Island. The tug PURVES and the ARUNDEL kept her under control for the night. Later the same night, the Canadian ship LABRADOC was caught in the storm. Fifty-knot winds and 15-ft waves reportedly shifted her cargo, causing a dangerous list about 25 mi north of Fairport in Lake Erie (fig. 21). Most of her crew was airlifted from the vessel after daybreak. Captain Ray Chambers attempted to sail her to safety along the north shore, but all efforts failed; the remaining crew left by midafternoon. The ship proved tougher than the storm and remained afloat. When the weather calmed, the tugs ATOMIC and GLENBROOK took her in tow and headed for Pelee Passage. She grounded for a time in the shallow waters of the Passage, but finally made it to safety.

Early in the month the Great Lakes were visited by

Figure 21.--The Canadian freighter LABRADOC is washed by waves while aground in Lake Erie near Ashtabula, Ohio. She later grounded again while under tow in Pelee Passage but managed to survive. Wide World Photo.

a new Canadian icebreaker, the PIERRE RADISSON. She transited the Seaway and headed for Thunder Bay, Ontario, for a spring workout. On April 7 the Upper Lakes Fleet christened their new boat, the CANADIAN TRANSPORT.

Slightly below-normal temperatures highlighted the second week of April. Shipping picked up and so did icebreaking. Over 70 direct icebreaking assists were logged that week alone. The hard spring ice took its usual toll of ships during midmonth. On Lake Superior the FRASER reported $4,000 damage, the J.L. MAUTHE $10,000, ARTHUR ANDERSON $5,000, JOHNSTOWN $3,000, and the REISS MARINE $7,500 damage. On Lake Michigan the BENJAMIN FAIRLESS and the JUPITER both had damages of $1,500. The JUPITER also sustained $10,000 damage in Detroit.

Very little ice was left on the Lakes by the end of April due to above-normal temperatures and sunshine. Precipitation was heavy in some sections the last week of the month. Ice-free waters were reported in Lake Michigan and Green Bay, across the Straits, and through Lake Huron including Saginaw Bay. Some drift ice remained in the North Channel. On Lake Erie the only remaining ice was in the extreme eastern end near Buffalo. The St. Mary's River was ice free, but ice remained loose in the eastern coves of Whitefish Bay. There was also considerable drift ice across the western half of Lake Superior, in Marquette harbor, and around Munising. Solid ice was still locked in between Isle Royale and Thunder and Nipigon Bays. Only about 25 vessels were directly assisted by Coast Guard tugs and buoy tenders during the last half of April; but numerous preventative icebreaking missions were performed, which undoubtedly kept ships moving that would have become beset.

Below-normal temperatures in early May slowed the decay of the ice field in western Lake Superior, and it was late in the month before the last cubes disappeared from the shipping lanes. The STADACONA had the honors of being the last vessel of the season to require direct assistance. She was helped from Duluth by the CGC MESQUITE. "Operation Taconite" was terminated on Lake Superior on May 9.

SUMMARY

For the third consecutive year in a row, severe winter weather was observed throughout the Great Lakes region. Conditions were especially severe in the western Great Lakes, where average temperatures were almost 4°F below normal. In addition, the Lake Michigan basin experienced record snowfalls with blizzard-like conditions several times during the winter. A total of 114 vessels, plus 10 foreign ships, and an estimated 25 fishing craft participated in the extended-season operations. This was down slightly from the previous year.

New regulations on the St. Lawrence Seaway System brought order to the annual exit of "salties," and no serious problems developed during December. In spite of very severe midwinter conditions, shipping continued unabated from the Upper Lakes through the locks at Sault Ste. Marie. Damages, however, were at an all-time high as ships were continually pounded by ice. For the first time in documented history the Great Lakes were almost frozen over simultaneously in late February. This contributed significantly to the amount of icebreaking required by the Coast Guard icebreaking fleet. The cargo tonnage carried by commercial ships directly assisted by the Coast Guard was less than half that of the previous season. The figure is misleading, however, because the number of preventative icebreaking missions performed by the Coast Guard fleet doubled this year. Commercial tonnage which benefited from these missions is unknown. The dollar values increased significantly from the previous season, but most of the increase can be attributed to inflation and better record-keeping by both commercial and government sources.

All in all, it was a very tough and costly year for the Great Lakes marine industry and their United States and Canadian government support forces.

ACKNOWLEDGMENTS

Icebreaking data and casualty data were supplied from records of the Ninth Coast Guard District, Cleveland, Ohio. Ice information was derived from records of the National Weather Service Forecast Offices in Ann Arbor, Mich., and Cleveland, Ohio. Other information was extracted from Lake Log Chips, a publication of the Center for Archival Collections at Bowling Green, Ohio.

WE OF NOAA ARE MAKING USE OF THIS SMALL AMOUNT OF SPACE TO EXTEND OUR THANKS TO ALL THE SHIPS' OFFICERS WHO ROUTINELY TAKE SHIPBOARD WEATHER OBSERVATIONS. TO US THESE EXCELLENT OBSERVATIONS ARE PRICELESS. WE CERTAINLY DO APPRECIATE RECEIVING THEM ON A REGULAR BASIS.

Hints to the Observer

Donald Cable
National Climatic Center
Environmental Data and Information Service, NOAA
Asheville, N.C.

CODING APP AND 99PPP GROUPS

Edit of observations on NOAA Form 72-1, Ship's Weather Observations, by the National Climatic Center (NCC) has revealed widespread problems with the 3-hr pressure change entries. The following are some correct and incorrect examples:

Correct
(when 3-hr change is equal to or greater than "99"):

Given 3-hr change	pp	Additional message groups and remarks
9.9 mb	99	99099
10.0 mb	99	99100
12.5 mb	99	99125

Incorrect:

app's of 401, 200, 700, etc., are not possible; an "a" of "4" indicates a steady pressure; therefore, the only acceptable entry for "pp" following "a" = "4" is "00"; "a" of "2" (pressure rising) or "7" (pressure falling) is used to indicate changes other than "00".

Tips to the Radio Officer

Thomas H. Reppert
National Weather Service, NOAA
Silver Spring, Md.

EXPANDED SERVICE AT WLO, MOBILE, ALABAMA

Radio station WLO, Mobile, Alabama, will soon be adding two additional NWS products to their marine weather broadcast schedule. They are the Gulf of Mexico Loop Current Bulletin and eastern Pacific forecasts and warnings.

Vessels entering the Pacific Ocean from the Panama Canal often experience difficulty receiving weather broadcasts because of poor propagation from West Coast radio stations. The WLO broadcast will provide a strong signal into this area, which under favorable conditions will carry as far west as Hawaii.

The Loop Current Bulletin will be available for the first time as a radio broadcast (see Mariners Weather Log, Nov. 1978). Ships transiting the Gulf and commercial fishermen have long used this current to their advantage.

Broadcast schedule details will be reported as they become available.

COAST GUARD RADIO STATION ADAK (NOX)

On October 1, 1979, U.S. Coast Guard Radio Station Adak (NOX) ceased operations as a manned station. All communications equipment will be remotely controlled from the Coast Guard Communication Station Kodiak (NOJ) who will answer all calls directed to NOX.

CORRECTIONS TO WORLDWIDE MARINE WEATHER BROADCASTS (JANUARY 1979 EDITION)

Page 11
1-0320
Curacao, Netherlands Antilles PJC
Delete Frequency 4334

Page 12
1-0385
Thurso, Scotland GXH

0030	3724 7504.4	W,A
0630, 1900	do.	W,F
1230	12691	W,A

Page 17
1-0703
Olinda, Brazil PPO

0100, 0600, 1000, 1200, 1500, 2100	480	S^2
0200, 0700	4298 8520 12840 17162	W,A,F
1830	do.	W,A,LR,SR

Page 19
1-0770
Pt. Reyes CA NMC
Area:
(a) North Pacific; Equator - 30°N, east of 140°W
(b) North Pacific; north of 30°N, east of 160°E
(c) Coastal Waters areas 3 and 4.
(d) Equator northwards, east of 160°E
(e) Coastal Waters, areas 5 and 6
(f) Coastal Waters, areas 1 and 2 plus Strait of Juan de Fuca and Inland waters of Western Washington.

0030, 0630 1920, 2100	4346[6], 8682 12730, 17151.2[7]	S,F[2]
0200, 1600	472	
0300, 1700	472	
0400, 1830	472	
H + 28, H + 48	472	W[3,4,5]

1. See figure 12
2. Areas a and b
3. Area C
4. Areas d and e, remotely keyed at Long Beach, CA
5. Area f, remotely keyed at Astoria, OR
6. Used only at 0630
7. Not used at 0630

1-0810
Long Beach, CA NMQ
Delete broadcast details. Insert, See 1-0770

Page 20
1-0920
Astoria, OR NMW
Delete broadcast details. Insert, See 1-0770

Page 69
3-0320
San Francisco, CA USA - NMC
Area:

(a) 10 degrees S to 40 degrees N, 78 degrees W to 160 degrees W.
(b) North of 30 degrees N, east of 160 degrees E.
(c) North Pacific.
(d) 500 NM of coast.

Frequency (kHz):

4344.1 [1]
8680.1
12728.1 [2]
17149.3 [2]

0000	Schedule (Monday only)
0100	[3]Wind, weather and sea state prog VT 18Z [4]18Z surface analysis [4]Surface prog VT 00Z [4]Sea state prog VT 00Z [5]Extended outlook 72/96 hr.
0300	[6]18Z ocean thermal analysis - Wash/Ore coast [6]18Z ocean thermal analysis - Calif coast [6]18Z ocean thermal analysis - Baja Calif coast [5]18Z ocean thermal analysis - North Pacific
0500	[4]00Z surface analysis [3]00Z wind, weather, and sea state analysis [4]Sea state prog VT 00Z [5]Extended outlook 72/96 hr
0700	[4]00Z surface analysis [3]00Z surface analysis
1500	[6]18Z ocean thermal analysis - Wash/Ore coast [6]18Z ocean thermal analysis - Calif. coast [6]18Z ocean thermal analysis - Baja Calif. coast
1700	[4]12Z surface analysis [3]12Z wind, weather, ana sea state analysis
2000	[4]12Z surface analysis [3]12Z wind, weather, ana sea state analysis
2300	[3]Wind, weather, and sea state prog VT 18Z [4]18Z surface analysis [4]surface prog VT 00Z

[1]Not used for 1700, 2000, and 2300 transmissions.
[2]Used for 1700, 2000, and 2300 transmissions only.
[3]area a
[4]area b
[5]area c
[6]area d

Page 73
3-0460
Nairobi, Kenya 5YE
Delete frequency 5127.
Frequency 17365 will be used 24 hrs daily.

ACKNOWLEDGMENTS
Thanks to H.P. Libuda, CG COMMSTA San Francisco, and the R.O. of the M.S. KIELDRECHT for recent information relative to the marine weather program.

Hurricane Alley

Dick DeAngelis
Environmental Data and Information Service, NOAA
Washington, D.C.

POSSIBLE NEW WORLD PRESSURE RECORD

Typhoon Tip may be responsible for the lowest sea-level pressure ever recorded (table 4). On October 12 1979, at 0443 a reconnaissance aircraft reported a dropsonde pressure of 870 mb. The 700-mb height was 1944 m. This tops the 876 mb and 1984 m recorded during typhoon June on November 19, 1975, at 0843. A detailed report on Tip will appear in the January 1980 issue in the Rough Log for October.

Table 4.--Record low pressures

1.*	870 mb	Typhoon Tip	Oct. 12, 1979
2.	876 mb	Typhoon June	Nov. 19, 1975
3.	877 mb	Typhoon Nora	1973
4.	877 mb	Typhoon Ida	1958
5.	887 mb		Aug. 18, 1927
6.	892 mb	Labor Day hurricane	Sept. 2, 1935
7.	905 mb	Hurricane Camille	1969

*pending verification

TROPICAL CYCLONE WATCH - 1979

Tables 5 and 6 below tabulate world tropical-cyclone activity from January through October 1979. These statistics are preliminary, but do give an idea as to current tropical-cyclone activity. The month is the month in which warnings were first issued; after final analysis the month could change if the storm formed at the end of the preceding month. The figures in parentheses represent those tropical storms that have reached hurricane or typhoon strength. Table 7 shows tropical-cyclone activity from 1965 through 1977 for comparison.

Table 5.--Tropical cyclone watch, 1979

Month	North Atlantic	Western North Pacific	Eastern North Pacific	North Indian	South Indian	Australia-South Pacific	World Total
January		1(1)			1(1)	3(1)	5(3)
February					1(1)	4(1)	5(2)
March		1(1)			1	2(2)	4(3)
April		1(1)			3(1)	1	5(2)
May		1	1(1)	1(1)			3(2)
June	1		1	1			3(0)
July	2(1)	4(2;	2(1)				8(4)
August	3(2)	2(2)	2(2)		1		8(6)
September	2(2)	6(2)	1	2(1)	1		12(5)
October		3(2)	2(1)	1			6(3)
November							
December							

Table 7.--Tropical Cyclones, 1965 to 1977

Month	North Atlantic	Eastern North Pacific	Western North Pacific	North Indian	South Indian	Australia-South Pacific	Total	Average
January	0(0)	0(0)	9(5)	2(1)	29(17)	52(20)	92(43)	7.1(3.3)
February	0(0)	0(0)	4(1)	0(0)	30(16)	41(16)	75(33)	5.8(2.5)
March	0(0)	0(0)	6(1)	0(0)	15(5)	39(18)	60(24)	4.6(1.8)
April	0(0)	0(0)	11(9)	4(2)	6(1)	18(6)	39(18)	3.0(1.4)
May	1(1)	5(3)	14(10)	14(5)	3(0)	4(3)	41(22)	3.2(1.7)
June	7(4)	24(9)	20(13)	5(1)	0(0)	0(0)	56(27)	4.3(2.1)
July	11(6)	41(16)	60(35)	2(0)	1(0)	2(0)	117(57)	9.0(4.4)
August	30(22)	53(31)	67(38)	2(1)	0(0)	0(0)	152(92)	11.7(7.1)
September	37(23)	41(20)	63(43)	11(4)	1(0)	0(0)	153(90)	11.8(6.9)
October	15(9)	20(10)	50(40)	16(7)	5(3)	4(1)	110(70)	8.5(5.4)
November	3(2)	4(0)	34(19)	19(8)	5(3)	18(7)	83(28)	6.4(2.9)
December	0(0)	0(0)	11(4)	11(4)	21(6)	33(15)	76(29)	5.9(2.2)
Total	104(67)	188(89)	349(218)	86(33)	116(50)	211(86)	1,054(543)	
Average	8.0(5.2)	14.5(6.8)	26.8(16.8)	6.6(2.5)	8.9(3.8)	16.2(6.6)	81.1(41.8)	
Percent hurricane	64%	47%	63%	38%	43%	41%		

HURRICANE ALLEY TRACKS

The tropical cyclone information in this column is usually of a preliminary nature. The attempt is to get the information out without the long delays, some-

Table 6.--World tropical cyclone watch, 1979

North Atlantic			Western North Pacific			North Indian			Australia-South Pacific		
Ana	TS	June	Alice	TY	Jan.	17-79	H	May	Gordon	H	Jan.
Bob	H	July	Bess	TY	March	18-79	TS	June	Greta	TS	Jan.
Claudette	TS	July	Cecil	TY	April	22-79	TS	Sept.	Henry	TS	Jan.
David	H	Aug.	Dot	TS	May	23-79	H	Sept.	Judith	TS	Feb.
Elena	TS	Aug.	Ellis	TY	July	24-79	TS	Oct.	Kerry	H	Feb.
Frederic	H	Aug.	Faye	TS	July				Leslie	TS	Feb.
Gloria	H	Sept.	Gordon	TS	July	**South Indian**			Rosa	TS	Feb.
Henri	H	Sept.	Hope	TY	July	Benjamine	H	Jan.	Hazel	H	March
			Irving	TY	Aug.	Celine	H	Feb.	Meli	H	March
Eastern North Pacific			Judy	TY	Aug.	Ivan	TS	March	Stan	TS	April
Andres	H	May	Ken	TS	Sept.	Idylle	H	April			
Blanca	TS	June	Lola	TY	Sept.	Jane	TS	April	TS = tropical storm		
Carlos	TS	July	Mac	TS	Sept.	Kevin	TS	April	TY = typhoon		
Dolores	H	July	Nancy	TS	Sept.	20-79	TS	Aug.	H = hurricane		
Enrique	H	Aug.	Owen	TY	Sept.	21-79	TS	Sept.			
Fefa	H	Aug.	Pamela	TS	Sept.						
Guillermo	TS	Sept.	Roger	TS	Oct.						
Hilda	TS	Oct.	Sarah	TY	Oct.						
Ignacio	H	Oct.	Tip	TY	Oct.						

times years, required to finalize the data. When these final data are compiled we present that too. This means that the tracks are usually based on warning and satellite positions. These positions may be different from the final ones; however, for illustrative purposes they are fine. This is why we often reduce these charts to less than page size. When compared with the final tracks, they are often very close.

SOUTH INDIAN OCEAN - JULY AND AUGUST

As can be seen in table 5 an unusual event occurred when a tropical cyclone developed in the South Indian Ocean during August. It is the first one since 1965. It wasn't much of a storm (fig. 22). It lasted about a week and reached its peak intensity on the 29th when winds climbed to an estimated 50 kn. However, by the 31st the storm had weakened to depression strength.

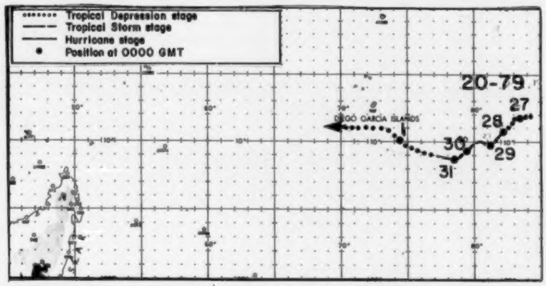


Figure 22.--An out-of-season South Indian Ocean storm threatened the Diego Garcia Islands in August.

On the Editor's Desk

NEW ADDRESS FOR PMO - PANAMA CANAL

The following is the new address for the Port Meteorological Officer at the Panama Canal, Republic of Panama:

Mr. Robert Melrose
Port Meteorological Officer
National Weather Service, NOAA
Box 1301
APO Miami 34005

The telephone number is 43-1565. For mail within the Republic of Panama substitute Fort Davis, Republic of Panama for APO Miami 34005.

NEW NATIONAL WEATHER SERVICE MARINE OBSERVATIONS PROGRAM LEADER

Jerry Nickerson recently became the new Marine Observations Program Leader. He replaces Robert Schoner who retired. Mr. Nickerson previously was a meteorological officer and researcher with the U.S. Navy.

Jerry has been coordinating his operations with those of the U.S. Navy and Coast Guard. The Navy and Coast Guard are valuable sources of data. The Navy supplies most of the radiosonde upper air soundings at sea, frequently from remote data-sparse areas.

Jerry is currently visiting the Port Meteorological Officers servicing ships at the major ports.

HUGE NATURAL OIL SEEP FOUND IN NORTH ATLANTIC

NOAA scientists have discovered an oil-rich layer of water hundreds of miles long and hundreds of feet beneath the surface of the southwestern North Atlantic Ocean. It is estimated to contain at least a million tons of crude oil, apparently from a natural oil seep in the ocean floor.

While the oil is too dispersed to be recovered for energy uses, this discovery could force drastic revisions in estimates of how much oil is naturally present in the sea. The oil layer appears to contain almost twice the amount used by many scientists--0.6 million tons--to describe the amount of oil annually leaked into the global ocean from all natural sources. If estimates have been this far off for this one area of the ocean, without considering seeps in the Gulf of Mexico, South China Sea, Persian Gulf, and other oil-rich areas, then there must be many times more oil in the sea than was formerly believed.

In a recent issue of Science, four scientists from NOAA's Atlantic Oceanographic and Meteorological Laboratories in Miami, Fla., reported the oil-rich layer was some 800 mi long and contained concentrations of crude oil of 3 to 12 mg of oil in every liter of sea water taken at the 650-ft (200 m) depth. If this concentration is multiplied by the number of liters in a volume of ocean 800 mi long by 1 mi wide by 328 ft thick, it is a lot of oil.

The layer was detected last year some 700 mi northeast of the Antilles island chain during a cruise of the NOAA ship RESEARCHER. High concentrations of hydrocarbons in water taken at the 650-ft depth were noted as the ship sailed southwestward into the Caribbean. Samples taken beneath and above the oil layer, as well as northeast and southwest of the layer, had hydrocarbon concentrations and distributions typical of the open ocean.

Shipboard analysis of water samples and subsequent analysis made at the Miami laboratories, as well as at Woods Hole Oceanographic Institution and Scripps Institution of Oceanography, confirmed the hydrocarbon was crude oil in an "accommodated state"--a kind of chemical middle ground between being dissolved and in droplet form.

Other tests indicated the oil was a biochemically weathered crude that had not lost any constituents to evaporation, indicating it had never surfaced at sea. Comparisons between the characteristics of sunken tars and the subsurface oil indicated the oil had weathered underwater for 1 to 2 yr before the NOAA scientists found it.

The average oil concentration of 6 mg/l was 5 to 10 times that found in "polluted" waters. Most organisms would be sickened or killed by this level of oil contamination. However, during a follow-up voyage this year (which failed to locate the oil layer in the same area) 100 percent of the microorganisms found at 200 m were

those which can use petroleum as a carbon source. In addition, the hydrocarbon levels in the area had returned to values typical of the open ocean.

The scientists concluded the most likely source of the layer was a seep on the Venezuelan or Trinidad continental shelf. They stressed that the discovery of large quantities of oil naturally present in the sea does not reduce the destructive potential of oil spilled at the surface. Oil on the surface can wind up on beaches and in the upper, most productive layers of the ocean.

THE DECADE OF THE 80'S: CAN THE OCEANS CATCH THE ATMOSPHERE?

The following remarks were made by Richard A. Frank, Administrator, NOAA, at OCEANS '79 in San Diego, Calif., September 17, 1979.

"Last year, I had the honor and the pleasure to be chairman of Oceans '78. We considered temporal problems during what I believe was a very enlightening session in Washington, D.C. Oceans '79, the last conference of the 70's, induces one to look forward to the next decade--not just to annual issues or even those that span one administration.

"During the 1980's, I believe agencies concerned with the well-being of the oceans, including NOAA, will focus on the oceans as a whole in connection with two discrete environmental subjects--pollution and climate. Pollution is a critical subject, for the evidence is becoming undeniable that the immense amounts of pollutants reaching the oceans can adversely affect not only limited areas but on a grand scale. Increased climate research is timely, for we have finally reached the point where we understand that study of various attributes of the oceans can provide the clues to the origins of climate, the prediction of climate, and conceivably the partial control of climate.

"The answers to these broadscale questions will come from a broadscale look--at the oceans as a whole. Thus, one of our major technological challenges of the 80's will be to design the parts of a system that can measure the global oceans.

"The contrast in our knowledge and activities of the atmosphere with those of the ocean reveals how far behind the oceans are and what we should strive for.

"The atmosphere is regularly and extensively monitored. Air pollution measurements are taken nationwide. We have accurate and precise information on the contents of the air we breathe. If it were bottled, we could comply with a Food and Drug Administration requirement to list its ingredients. Sophisticated remote sensors on satellites record temperatures as a function of height--from the surface to the upper stratosphere. Thousands of surface and upper air measurements are taken from land bases worldwide every day. The information is effectively distributed throughout the world. Small scale weather phenomena, such as tornadoes, are extensively documented and analyzed.

"We have no wet technological analogue to this comprehensive atmospheric monitoring system. Only on a gross scale and in limited locations do we know about differences in the composition of ocean waters, for example, as a result of pollution. Small scale events, such as short-term anomalies of particular ocean currents, are rarely monitored.

"This disparity between the well-being of atmospheric and oceanic sciences has many origins, including the belated appreciation of the potential of the ocean. In any event, our job is to close the gap.

"The technology to accomplish this task will entail both measuring the ocean surface, and measuring sub-surface conditions. The scientific uses of the data from these two areas will often be the same or intimately related. But the techniques used to obtain the data often are apt to differ.

"Satellites are now far and away the most cost effective means of measurements of waves, surface temperatures, and sea-surface elevation. SEASAT, the first satellite designed specifically to study the oceans, lasted only 99 days, but it gave us valuable information about ocean waves, surface slopes, and temperature. We must refine the remote sensing devices needed to measure these characteristics of the ocean's surface. The altimeter on SEASAT was accurate to approximately 10-20 cms. Even more precise information will be necessary if surface elevations are to be used to estimate deep ocean currents with sufficient accuracy to be useful for climate prediction.

"Subsurface ocean measurements will be a requisite to climate prediction and the understanding of the dynamics of ocean pollution. Subsurface data may be more costly than surface measurements, since remote sensing devices on satellites probably cannot do the job. To obtain adequate subsurface data, we will need better measurement techniques, such as in situ sampling and analysis systems and acoustical devices.

"Drifting buoys could meet many of our subsurface data needs, but only if someone accepts the challenge to fashion more sophisticated and versatile buoys. During the global weather experiment, inexpensive drifting buoys were dropped from aircraft over extensive areas of the southern hemisphere. Data from them, providing information on ocean currents, temperature, and pressure, were monitored by satellites. The experiment proved a major success and gave information from areas we knew little about. But, the buoys gave us primarily surface data. Why not drifting buoys capable of vertical sensing in the water column? Buoys containing devices capable of performing chemical analysis would revolutionize ocean pollution programs.

"A vast network of vessels is simply too costly to consider for extensive measurement of the oceans. We perhaps should focus on making the vessels we can afford more efficient. We should pursue utilizing remote sensing techniques from ships or other platforms in combination with the more traditional function of obtaining direct samples.

"Although we need information about all the ocean, we will want particularly detailed data about areas near the coast both because the coastal ecosystems are highly productive and fragile and because they will be the sites of a high percentage of pollutants. President Carter has endorsed 1980 as the year of the coast. That highest level interest could serve as the impetus to progress with such technology.

"The new coastal ocean dynamic application radar--CODAR--is illustrative of the technology that will be employed in the '80's. Perfected in the last two years under NOAA sponsorship, CODAR will enhance our technical capabilities to explore surface currents and to undertake baseline studies. Using Doppler techniques at two small portable shore stations spaced 30-40 kilometers apart, CODAR can provide a complete map of the surface currents over a 4,000 square kilometer area in approximately 15 minutes. It yields data to predict the transport of any materials borne by surface currents--such as oil pollutants or fish eggs. CODAR will increase our knowledge about zoo- and phyto-plankton, dominant components in the production of most of the world's oxygen.

"Over the next decade, the United States will make fundamental decisions on that technology which revolutionized the past ten years--satellites. More specifically, we will determine whether and when LANDSAT will become operational and whether SEASAT will have progeny. My impression is that we will relatively soon go into a LANDSAT operational phase, as we should, but that approval for a successor to SEASAT may be more difficult. SEASAT is too important to lapse; to abandon it now would simply let the application of technology to land issues advance further beyond ocean issues.

"I have thus far emphasized ocean pollution and ocean/climate interaction, but other areas of NOAA's responsibility, e.g., the management of our fish resources and the mapping and charting of the oceans cry out for technological innovation in various problem areas. For example, new fishing vessels specifically intended for use in the squid and pollack fisheries are under construction. These vessels contain major technological design advances.

"The challenge is yours. NOAA looks forward to the '80's as a decade of excitement and promise in our understanding of the ocean. We will not pursue technology for technology's sake, but the scientific needs for new hardware are patent.

"The lenient budget processes of the 1960's are a luxury of the past. But even in this era of fiscal restraint, I am optimistic that funds will be available for the right advances in ocean technology as we become increasingly aware of the importance of the oceans to our daily lives."

INTERNATIONAL ROCKET PROJECT TO COMPARE OZONE SENSORS

Scientists and engineers from five countries--Australia, Canada, India, Japan, and the United States--have gathered at NASA's Wallops Flight Center on Virginia's eastern shore to compare their techniques of gathering information about ozone in the Earth's stratosphere.

Twenty rocket-borne experiments were to be conducted during a 14-day period, starting October 21, in an effort to establish instrument precision and comparability. Resulting ozone data should provide information on ozone variability during the 14 days.

Four kinds of rockets--two-stage Nike Orion, single-stage Orion, Super Arcas, and Super Loki--will be used to carry the ozone-measuring instruments into the stratosphere. The rocket flights will coincide with orbiting satellite overpasses of Wallops for comparison of the rocket measurements with those of the satellites. Meteorological rockets and balloons, as well as ground-based equipment, also will be collecting ozone data.

New ground-measuring techniques to determine the distribution of ozone in the stratosphere will be tested. Several of the rocket payloads will be recovered in mid-air by the Wallops Skyvan aircraft.

Rocket-borne instruments in use worldwide employ different physical techniques to measure stratospheric ozone and have never been compared to establish possible systematic errors and other biases in their measurements. A systematic comparison of all the instruments is necessary if rocket ozone data is to serve as "ground truth" verification of satellite measurements, particularly as the latter are coming to be relied upon to detect global ozone trends.

This joint effort is sponsored by the World Meteorological Organization, the Federal Aviation Administration of the Department of Transportation, and NASA. Comparison of techniques is an important part of the world organization's Global Ozone Research and Monitoring Project since the use of satellite ozone measurements is placing increased importance on rocket data to verify, calibrate, and determine long-term stability of satellite instruments.

Objectives of the rocket flights are to compare the performances of rocket-borne instruments under con-

ditions that will:

- Establish the precision of various rocket ozone instruments;
- Assemble a common data base from rocket sounding;
- Establish reference points for evaluation and use of future data by each experimenter.

By accomplishing the stated objectives, the project should help in providing additional data for:

- Improving the accuracy of rocket ozone data used for validation of satellite ozone sensors;
- Establishing a selected set of upper level ozone profiles with greater accuracy;
- Determining ozone trends, if any, at altitude levels where current stratospheric models predict the greatest reduction in ozone densities due to anthropogenic (manmade) pollutants, such as fluorocarbons.

Participating organizations are the University of Adelaide, Australia; University of Saskatchewan and the National Research Council of Canada; Physical Research Laboratory and the Indian Space Research Organization of India; University of Tokyo and University of Tsukuba of Japan; and NASA's Goddard Space Flight Center in Greenbelt, Md., and the Wallops center.

HURRICANE PROJECT SEEKS IMPROVED STORM WARNINGS

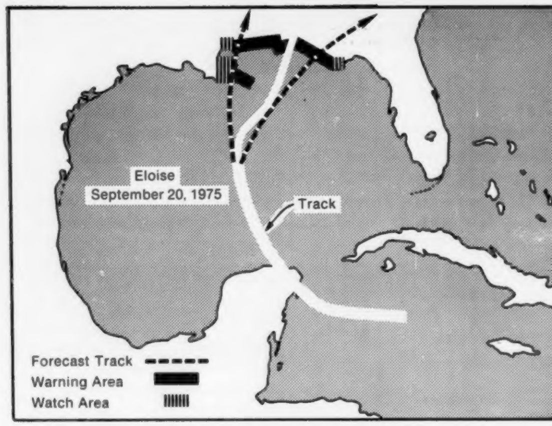
Hurricane-probing aircraft, scientists, and a satellite data relay gave NOAA hurricane forecasters a virtual seat inside approaching Atlantic storms this year and improved their ability to predict where hurricanes will come ashore.

The experimental effort, Project Hurricane Strike, kept researchers aboard NOAA aircraft inside advancing storms during the crucial 40 hr before the hurricanes make landfall.

As the airplanes' sensors recorded conditions in the hurricane, some of the measurements were transmitted via a geostationary NOAA satellite to the National Hurricane Center in Miami, where a computer display of data from the aircraft provided forecasters with a moment-to-moment knowledge of the position, winds, pressures, and other crucial characteristics of the storms as they approached landfall. This steady flow of information from within the hurricane permitted forecasters to narrow the coverage of their hurricane watch and warning messages with potentially large economic benefits to affected coastal areas.

The average coastline warned for a hurricane landfall is about 300 mi when the storm is coming straight in, according to Dr. Robert Sheets, a senior hurricane researcher at the National Hurricane and Experimental Meteorology Laboratory in Coral Gables. But significant damage from the hurricane generally occurs only over about a third of that area. For storms that move parallel to the shore, which is often the case for East Coast hurricanes, the warned area is much larger and affects many millions of people (fig. 23).

Wide-area warnings are costly and complicate the already difficult task of evacuating threatened coastal areas. Project Hurricane Strike was developed to see



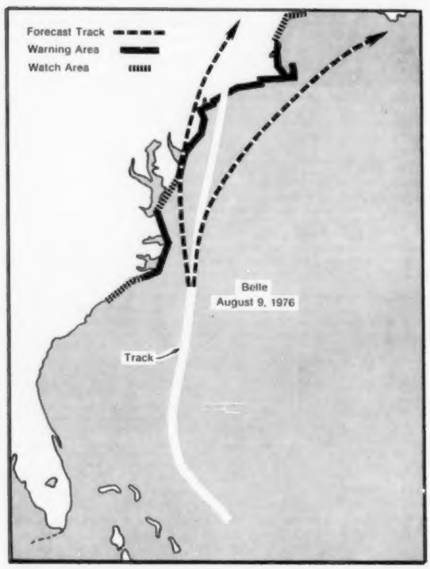


Figure 23.--Hurricanes Eloise (1975) and Belle (1976) are used to demonstrate NOAA's Project Hurricane Strike. The real track is the broad white line. The black dashed lines show the range of possible tracks predicted 24 hr before landfall. The black areas are those under hurricane warnings, and the notched areas are those under hurricane watch.

if research techniques could narrow the area being warned. It will also be the basis for a continuing research program to improve present predictive techniques. As more information is obtained on the detailed internal dynamics of hurricanes nearing land, it will be applied in mathematical models to improve further the ability to predict the time, place, intensity, ex-

pected storm surge and rainfall, and the area of possible destruction for hurricanes coming ashore.

The experiment will use four research aircraft: two WP-3D Orions and one C-130 Hercules, operated by NOAA's Research Facilities Center in Miami, and a Convair 990 operated by NASA's Ames Research Center. In a typical strike mission the aircraft monitor the storm for 40 hr before its predicted landfall, one flying at levels of 1,500 to 5,000 ft and another at 20,000 to 24,000 ft. Scientists from the Coral Gables laboratory are aboard to ensure a continuous flow of crucial information from the aircraft to the hurricane forecasters.

Initially, the researchers tried to determine the impact of the aircraft monitoring on the accuracy with which hurricane intensity and motion are predicted. They also explored techniques for predicting such characteristics as wind distribution, storm surge, and rainfall rates in terms of time and location.

ARGO MERCHANT REMINDER WASHES UP ON SCOTTISH SHORES

A reminder of the ARGO MERCHANT oil spill has washed up on Scottish shores 2-1/2 yr after the oil tanker sank on Nantucket Shoals. Luckily, the reminder which the waves cast ashore was a small yellow plastic disc and not a tar ball. The disc was one of 1,800 seabed drifters released by University of Rhode Island oceanographers. Its arrival on the Isle of South Uist off the western coast of Scotland has led to speculation that some of the oil from the largest U.S. oil spill might also have reached Scotland by the same path that the drifter took.

The ARGO MERCHANT sank in December 1977. Since most of the 7.7 million gal of oil which floated away from the wreck was only tracked for a short time, no one knows the ultimate fate of the oil. Since the drifter and the oil were released in the same location, there is the potential that tar balls from the spill could have washed up in Scotland, though no one knows what their size would be.

Oceanographers routinely track bottom currents with seabed drifters, which carry a stamped message asking the finder to send information about its recovery to the oceanography school. Although there currently is not money to continue scientific analysis of the tracking project, the University of Rhode Island is continuing to send a 50-cent reward for drifter information and is keeping a record of the returns. So far, 243 (or 14 percent) of the drifters have been returned, a high number for this type of project.

The Scottish drifter holds the long-distance travel record for the ARGO MERCHANT group. During the first year of the project 176 drifter messages were received, primarily from Nantucket, Martha's Vineyard, Cape Cod, and Rhode Island. The second year's returns came from the same locations as well as Long Island, Connecticut, Delaware, and North Carolina.

VTS FOR NEW YORK PORT NEARLY COMPLETE

A $7 million radar/television/communications network to monitor and assist vessel movements in New York harbor and its environs is nearing completion at the Coast Guard facility at Governors Island. The Vessel Traffic Service (VTS) will apply to virtually all significant traffic, right down to many of the harbor's sightseeing craft. It will also empower the Coast Guard to direct traffic in abnormal operating conditions.

The New York VTS is one of several in the United States, but so far it is the only one on the East Coast. The other systems are at Valdez (Alaska), Puget Sound, San Francisco, Houston, and New Orleans. No two systems are alike, as each follows the characteristics of its respective geographical location. For example, the New Orleans system covers an elongated stretch of water with mainly two-way traffic, compounded by long tug-barge strings and blind corners. It also has different adherence and communication rules.

New York is a relatively compact area, heavily trafficked in various directions at once, with the problems also compounded by blind turns. The VTS is intended to "take the element of surprise out of navigation." Its implementation elsewhere has created problems, especially with communications. In the case of New York, attempts have been made to provide sufficient VHF radio channels while personnel are being trained to avoid "overkill" in the amount of information they provide to shipping in the area.

Thus, in clear weather, a ship entering the harbor might only be told to expect so many ships coming the other way. In fog, however, the Vessel Traffic Center (VTC) might advise the ship exactly when and at what point it might expect to encounter other traffic. And in abnormal situations such as poor visibility, high traffic density, a ship proceeding into shallow waters, and so on, the VTC might issue specific instructions as to course and speed. The ship is expected to obey these instructions.

The system can handle some 1,000 vessels at any one time. Communications are being provided on VHF Channels 11, 13, and 14. One channel would not be able to cope with the expected traffic.

Drawing on trained signalmen or quartermasters, the VTC crew has been put through a rigorous training course in not only the radar, tracking, and communications equipment, but also in familiarizing themselves with the navigable areas within the system. This latter includes harbor surveys by virtually every form of applicable transport, such as Coast Guard cutter, tugboat, waster disposal barges, and oceangoing freighter.

They are expected to be familiar with every significant navigational marking in the harbor as well as the local terrain. Pass rate in examinations in some aspects of the training has to be better than 90 percent.

The VTC will be manned 24 hr a day with each shift under the command of a watch officer. The harbor area and its approaches have been split into five sectors, each watched by a radar, T.V. cameras, and a computerized progress predictor. The sectors are:

1. The Lower New York Bay and approach channels to a level with Coney Island;
2. The Narrows, the Kill van Kull, and Upper New York Bay to a level with Governors Island;
3. The Arthur Kill and Newark Bay;
4. The Hudson and East Rivers to just short of the Queensboro Bridge; and
5. The East River above the bridge, Hell Gate, the Harlem River, and the western end of Long Island Sound.

To monitor these sectors, the VTC has radar sites at Governors Island and Sandy Hook; 13 remotely controlled cameras at strategic sites at Tufts Point, N.J.,

Figure 24.--The U.S. Coast Guard icebreaker WESTWIND in open water and easier sailing. U.S. Coast Guard Photo.

Tremly Point and Arlington Terrace on Staten Island, Port Morris in the Bronx, and the Sovereign building and 60 East End in Manhatten; as well as communication sites in Rockaway, Manhatten, Staten Island, the Bronx, and Governors Island.

Additionally, there are several check-in sites at which a ship has to notify the VTC of its position. These assist the VTC in verifying the work of its own course/speed predictors. Finally, there are a number of Limited Traffic Areas through which ships can proceed only with VTC approval or under prior agreements. These number four in the Arthur Kill, one in the lower end of Newark Bay, one at the eastern end of Kill van Kull, another at the southern entrance to the East River, and three more around the Hell Gate and Long Island Sound approach to the East River.

USCG ICEBREAKER PENETRATES ARCTIC ICECAP

The U.S. Coast Guard icebreaker WESTWIND (fig. 24), conducting an intensive 7-week oceanographic study off the northern coast of eastern Greenland, penetrated further into the arctic icecap than any other U.S. icebreaker in history on August 28, coming within 375 mi of the North Pole. The study area, between latitudes 76° and 81°N, is known as a major outlet for frigid arctic currents and vast ice floes.

Six scientists aboard the WESTWIND hope to map the ocean bottom to within a few miles of the eastern Greenland coastline and collect other oceanographic data. When the mission is completed, the scientists expect to have collected 85 percent of the known data on the close inshore portion of this coast.

The WESTWIND's push into the arctic ice came when she reached the position of 85°45'N latitude, 6 mi north of the Greenland land mass. The previous record for an American icebreaker was held by the Coast Guard's SOUTHWIND, which reached 83°01'N in August 1970 in the Barents Sea, north of Russia.

The Milwaukee-based WESTWIND left her homeport July 1. She took advantage of high winds, which loosened the ice pack, and her two ice reconnaissance helicopters to navigate through narrow channels between the ice expanses to reach her goal. Some of the ice floes measured over 400 mi^2 and were up to 15 ft thick.

Prior to conducting the Greenland study, the WESTWIND and her 165-man crew provided icebreaker assistance for cargo vessels resupplying U.S. defense bases on the west coast of Greenland. During the winter season, the WESTWIND breaks ice on the Great Lakes, keeping shipping lanes open.

PUBLICATIONS OF INTEREST TO MARINERS

LEARN ABOUT LORAN-C

The U.S. Coast Guard is publishing a newsletter, The Loran-C Bulletin, for users and potential users of Loran-C. Items of general interest, corrections to published charts, schedules for implementation, and other such information is included.

Persons with questions or who wish to receive copies of the bulletin should write The Loran-C Bulletin, U.S. Coast Guard (G-WAN/73), Washington, DC 20590.

JOINT GUIDE TO GREAT LAKES ICE NAVIGATION

The United States and Canadian Coast Guard publish a Joint Guide to Great Lakes Ice Navigation. The latest issue covers the 1978-79 season. They are distributed to the Canadian and United States Coast Guard, Great Lakes Shipping Association, and the Lake Carriers Association.

WESTCOTT--THE FIRST HUNDRED YEARS

The name "Westcott" is a byword along the shores of the Great Lakes. To thousands of sailors on Lake vessels, it means contact with home. To vessel operators it means expediency and communication. To the philatelist it means one of the most unique mail services in the country. Operating within the shadows of the Ambassador Bridge in Detroit, the Westcott Agency today delivers mail, packages, and persons by means of a "floating post office" to vessels passing by on the busy Detroit River.

Gary Bailey, past editor of Lake Log Chips, has traced the company's history back to its formation over 100 yr ago. He has incorporated this into the maritime roots of the family which go back into the 1820's. The result is a short, but fascinating combination of fact and family legend which will be attractive to any follower of Lake lore. An added feature is over 30 rare photographs gleaned from Westcott family albums and other maritime-related agencies.

The 35-page booklet can be obtained from Center for Archival Collections, 5th Floor - University Library, Bowling Green State University, Bowling Green, OH 43403. The cost is $2.50 plus $.50 for postage and handling. (Ohio residents add 4.5% state tax.) Checks should be made payable to Bowling Green State University/CAC.

LETTERS TO THE EDITOR

NORTHWALL OF GULF STREAM

The following letter and illustration were sent by M. Horjus, Master of the OLEANDER, to Robert W. Baskerville, Jr., Port Meteorological Officer in New York. I have forwarded a copy of the letter to the Ocean Services Division of the National Weather Service, which monitors the Gulf Stream and also publishes the monthly summary gulfstream.

OL79/MH24 Hamilton, August 27, 1979

Mr. Robert W. Baskerville, Jr.
Port Meteorological Officer
30 Rockefeller Plaza
New York, NY 10020

Dear Sir:

Please find enclosed a handdrawn picture of part of our track from Bermuda to New York of August 21, 1979 (fig. 25). As this picture indicates, we draw a rhumbline, course 317 degrees true, along which our hourly Loran positions are shown in circles. The curved fulldrawn line shows the northwall of the Gulfstream as received from Portsmouth Radio, that date.

Observing this drawing, you will notice that on this voyage we encountered a fair westerly set just south of the northwall and an easterly set well north of this northwall of the Gulfstream. In other words, we think we experienced currents opposite the currents we normally encounter in this area.

Furthermore, on this date there was no wind, we did not change course, we were on Gyro-automatic steering, and our speed was 11.7 knots. These Loran positions were very accurate. The three *marked steps on this chart indicate an interval of 1H-20M, as the clock was set 1 hour slow.

I tried to contact you by telephone several times last Thursday, but did not succeed. Afterall, this information of our experience with the positions of the northwall of the Gulfstream on this date is maybe of more interest to you in writing as it is in conversation by telephone.

If these data are of any interest to you or if you wish more information, please let us know, so we could keep sending you these pictures if we think we have encountered abnormal conditions or could send this information in any form which you think is best. Especially on the good weather crossings, at this time of the year, there is not much else to report from our side on weather conditions.

Yours faithfully,

M. Horjus
Master cmv OLEANDER

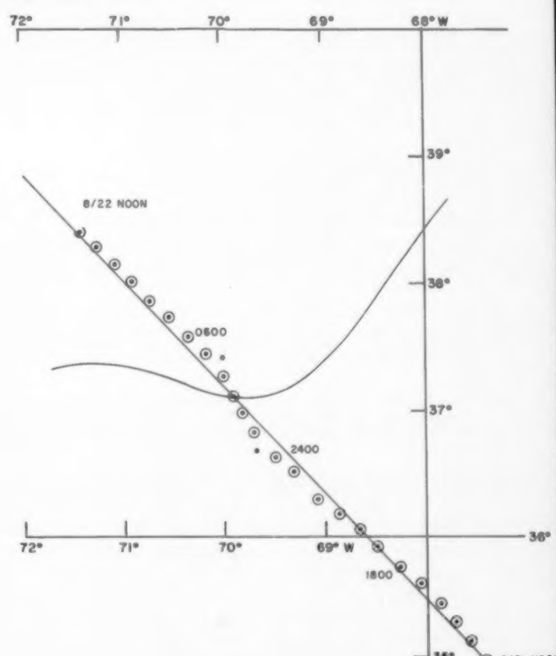


Figure 25.--The circled dots show the positions and track of the OLEANDER. The solid line shows the supposed position of the north wall of the Gulf Stream.

TUG STALWART AWARDED MARINER'S PLAQUE

The tug STALWART was selected to receive the Mariner's Plaque, an award given by the United Seamen's Service to officers and crews for outstanding seamanship in rescue operations at sea. Captain H. Darrel Davis and members of the crew also received the Mariner's Rosette in recognition of their outstanding courage and devotion to duty.

The following is the letter of recommendation submitted by the Crowley Maritime Corporation to the Select Committee of the Maritime Administration.

February 21, 1979

Gentlemen:

Crowley Maritime Corporation, Pacific Northwest & Alaska Division, P.O. Box 2287, Seattle, Washington 98111, takes pleasure in nominating Captain H. Darrel Davis as a candidate for the 1979 American Merchant Marine Seamanship Trophy.

Captain Davis was born in Olympia, Washington, June 20, 1926. His Z card no. is 10861 D-1. He holds an operator "oceans" document issued November 5, 1977. He resides at 1212 9th Street West, Seattle, Washington.

Captain Davis was master of the tug STALWART, official number 575,052, owned by San Diego Transportation Company of San Francisco, Calif., operated by the Crowley Maritime Corporation, Pacific Northwest & Alaska Division, Seattle, Wash. The tug STALWART is 199.1 gross tons, 135 net weight, 136' 2-1/2" x 36' 6" x 19' 2", powered by two EMD diesel engines developing 7,200 hp.

The tug STALWART departed Seattle towing two 400' x 100' barges in tandem, loaded with rail cars bound for Whittier, Alaska, on December 31, 1978. On January 5, 1979, at about 0500 local time at position 58°56'N, 140°21'W, a flare and apparent flashing light were sighted off the starboard bow. The STALWART's master, Captain Davis, was notified immediately at which time he ordered a course change to head for the light and called for a reduction in speed.

The tug STALWART, with Captain Davis at the conn, maneuvered to alongside approach. The lights were later determined to be a hand-held distress flare and a repeated SOS by flashlight. At 0520 January 5, 1979, the STALWART's search light spotted a liferaft. The STALWART was maneuvered to alongside the liferaft, where a heavy line was passed. The raft was brought alongside, and four survivors from the sunken crab boat OCEAN CAPE were brought on board the STALWART at 59°00'N, 140°21'W. The operation was completed and the tug STALWART resumed course for Whittier, and engines were brought up to full speed at 0545 January 5, 1979.

During this maneuver the wind was from the southeast at 10 kn with a light sea and moderate southeast swell approximately 15 to 20 ft. Captain Davis exhibited excellent seamanship practice in the skillful manner that the STALWART was maneuvered to a position to execute the rescue of the four seamen on the first attempt. With limited visibility and maneuverability, had the first attempt proved unsuccessful, the STALWART would have had to execute a round turn maneuver to make another pass, which could have brought the two barges into close proximity of the liferaft, possibly fouling same in the barges' bridle chains or overrunning the raft, with possible serious injury or loss of life.

The survivors of the OCEAN CAPE had been in the raft for 4 to 5 days. The vessel went down so quickly the crew only had time to don their survival suits. No distress call was transmitted from the OCEAN CAPE. Their condition, other than being hungry and cold with one sprained ankle, was deemed to be in no immediate medical danger.

Due to weather conditions at the time, Captain Davis advised the U.S. Coast Guard Juneau that helicopter evacuation might prove hazardous and the survivors remained on board the tug STALWART until about 0800 January 6, 1979, upon arrival in Whittier, Alaska.

The position of the liferaft was inshore from the normal shipping lanes from the Pacific coast and Alaska plied by Valley Tankers and Anchorage van ships.

Thank you for your consideration.

Very truly yours,

James T. Lowe
Vice President
Marine & Cargo Operations

PSYCHROMETER HOLDER

The following letter was sent by Julius L. Soileau, Port Meteorological Officer, Houston, Tex.

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL WEATHER SERVICE

October 5, 1979

Mr. Elwyn E. Wilson, Editor
Mariners Weather Log
NOAA, Environmental Data and Information Service
National Oceanographic Data Center

Dear Sir:

The National Weather Service provides portable psychrometers only to merchant ships. These are of two types: "sling"--which is pictured here--and "aspirated" (battery powered).

These photos describe some of the pride that the officers of the M.V. MARIA U have for their weather instruments. The ship's personnel built this convenient holder for the sling out of mahogany with a container for water to keep the wetbulb ready for exposure and a securing swivel latch. It is, in turn, well secured on the wall (bulkhead) grouped with the barometer and barograph (fig. 26).

The photography was done by Mr. Jovito Jumalon, second mate and weather officer on board, who is a recent graduate of the Merchant Marine Academy in the Philippines.

Respectfully,

Julius L. Soileau
PMO Houston, Texas

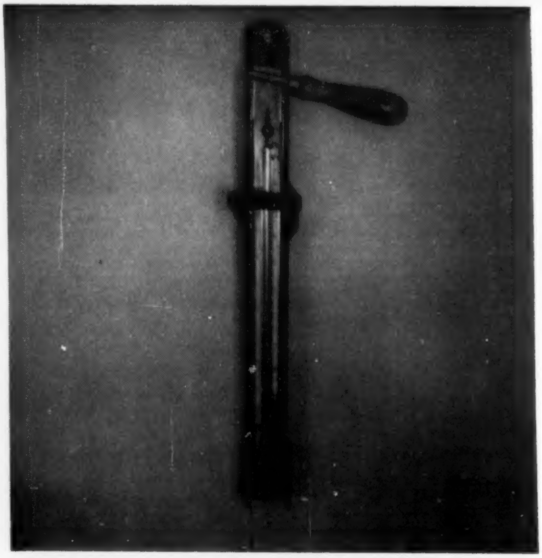


Figure 26.--The psychrometer in holder.

MARINE WEATHER REVIEW

The Smooth Log (complete with cyclone tracks, climatological data from U.S. Ocean Buoys, and gale and wave tables) is a definitive report on average monthly weather systems, the primary storms which affected marine areas, and late-reported ship casualties for 2 mo. The Rough Log is a preliminary account of the weather for 2 more recent months, prepared as soon as the necessary meteorological analyses and other data become available. For both Smooth and Rough Logs, storms are discussed during the month in which they first developed. Unless stated otherwise, all winds are sustained winds and not wind gusts.

Smooth Log, North Atlantic Weather

May and June 1979

SMOOTH LOG, MAY 1979--There were no clear-cut paths that the LOWs traveled this month. Each storm seemed to wander alone, and many wandered as if they had no clear-cut destination. The closest to what might be called a favored path was from the northern Plains States toward the Labrador Sea and from south of Kap Farvel toward the North Sea.

The mean pressure pattern looked more like its climatic normal counterpart, except it was more intense. A 1007-mb LOW was off Norway near 68°N, 10°E. The Azores High was 1025 mb only a few miles from its 1022-mb partner. There were two small low-pressure centers over northern Quebec and Labrador. A 1012-mb center southeast of Kap Farvel on the climatic normal was missing from the monthly mean.

The most prominent departure from normal was a minus 8-mb center west of central Norway. There was a large positive anomaly with a plus 4-mb center off Spain, a plus 6-mb center east of Kap Farvel, and a plus 4-mb center off the East Coast and over Labrador.

The upper air at 700 mb had a long-wave trough over the eastern United States with a short-wave trough east of Newfoundland. There was also a long-wave trough stretching south over England. The upper air anomalies closely paralleled those at the surface.

Extratropical Cyclones--This was a rather mild month. There were few storms, and none of them were especially severe. It was more like a summer month than a spring one.

An inverted trough was moving across the northern tier of states, and a LOW formed near Chicago on the 3d. The LOW almost lost its identity on the 4th and 5th as another LOW formed to the north and moved northward. The system deepened over Newfoundland on the 6th as more maritime air was fed into the circulation. The island of St. Pierre on the south coast measured 40 kn. The SEALAND MARKET near the cold front at 37°N, 61°W, had 16-ft seas and 20-ft swells. At 1200 the AMERICAN ALLIANCE (44°N, 46°W) reported only 30-kn winds, but she had 25-ft swells. A ship with the call sign VOPL reported 52-kn westerly winds near the Gaspe Peninsula. At 1800 the FORT CALGARY was south of Cape Race with 25-ft waves. On the 7th and 8th the storm was stationary slightly east of St. John's. Several ships had winds in the gale category and two had winds in the 50-kn range. The highest waves were 20 ft.

At 1200 on the 9th the LOW was 995 mb near 44°N, 45°W. The SEA-LAND VENTURE was 250 mi to the south with 33-ft swell waves. On the 11th the LOW was drawn into a counterclockwise loop by passage to the north of another LOW. There were a few gales observed. On the 12th this LOW absorbed the interloper. The BREEHELLE (50°N, 27°W) had 58-kn southwesterly winds east of the occlusion. The LAURENTIAN FOREST found 26-ft swells south of the center as did several other ships in the area. On the 13th the OLAU WEST near 60°N, 35°W, was buffeted by 55-kn northerly winds and 30-ft seas. At 1200 the 984-mb storm was near 61°N, 25°W. Lima measured 40-kn winds, which became 45 kn on the 14th with 20-ft seas. The COMET was at 57°N, 20°W, with 25-ft swell waves. By the 16th the storm had disappeared over northern Norway.

As the LOW described above moved south of Iceland there was a weak col area over the Labrador Sea, and this LOW occupied it on the 14th. The storm moved due east along latitude 56°N. The storm was almost centered on OWS Lima on the 16th at 0000. At 0600 her winds were 39 kn. Later at 1800 the GXOB near 50°N, 18°W, had 55-kn winds and 26-ft seas. As the storm moved north of Ireland on the 17th Romeo had 20-ft seas. The LOW disappeared over the North Sea on the 18th. At the same time a LOW popped up near Cape Finisterre and the TAUPO had 45-kn northerly winds. Far to the south the ELAT also found 45-kn winds. On the 19th the LOW moved over Spain and then northward over England.

This Texas LOW formed over the northeastern corner on the 22d as a frontal wave. It brought heavy rain and thunderstorms to the southeastern states. Another LOW was moving southeastward out of the upper Midwest. They combined forces on the 24th near Baltimore. On the 25th the GYPSUM KING off Fort Pierce, Fla., had 45-kn winds. Later in the day the EXXON BOSTON, east of Cape Hatteras, had 40-kn winds and 25-ft seas. The EXXON BOSTON was sailing southward down the coast and reported 21-ft seas on the 26th. The SEALAND MARKET was farther east (37°N, 65°W) with 45-kn southerly winds and only 12-ft waves.

The LOW was moving northeastward just inside the coast. On the 27th it turned northwestward. Two ships near 48°N, 61°W, in the Gulf of St. Lawrence had 40-kn easterly winds. On the 28th the LOW was north of

Lake Huron. It turned southeastward and died on the 30th.

This LOW formed south of the Denmark Strait at 54°N. There already was cyclonic circulation to the south. The Azores High had been firmly entrenched near 35°N, 40°W, for over a week. The LOW was 994 mb near 51°N, 26°W, at 0000 on the 27th. The LEONID LEONIDOV 250 mi to the southwest had 18-ft waves with 35-kn winds. At 1800 the STREAMBANK near 48°N, 25°W, had 44-kn westerly winds. The storm was north of OWS Romeo on the 28th and treated her to waves up to 20 ft although the winds were only 25 kn. On the 29th the storm disappeared north of Ireland.

This storm formed on the 29th in a spot favored for such things--near Kap Farvel. The Azores High had a double center, but the eastern one dissipated on the 31st as the LOW moved southeastward and the HIGH became the Bermuda High. By 1200 the LOW was 990 mb near 52°N, 27°W. Two ships in the southwest quadrant had 35-kn gales, and the NOVA SCOTIA east of the front had 20-ft swell waves from the south. The H1070 was near 47°N, 40°W, or about 600 mi southwest of the storm with 45-kn winds and 25-ft seas.

At 1200 on June 1 the storm was 992 mb near 46°N, 29°W. Romeo had 40-kn winds and 20-ft seas. The ATLANTIC CINDERELLA near 47°N, 39°W, found 45-kn winds. On the 2d Romeo and the ACHILLES nearby had 40-kn winds and 25- and 28-ft waves, respectively. On the east side of the storm near latitude 50°N several ships had gales and waves to 25 ft. A British ship in the same area had 52-kn winds and 23-ft waves. The LOW was now traveling northward. On the 3d at 1200 it was 996 mb near 55°N, 27°W. The ALBRIGHT PIONEER found 23-ft waves 350 mi to the south. On the 4th the storm was gone.

Casualties--The 9,057-ton Great Lakes carrier ASHLAND ran into the North Entry Pier at Duluth on the 9th, when thick ice prevented the vessel from making a turn in time. During a storm on the 10th the 180-ton American supply vessel DELTA SEAHORSE hit the drilling platform RANGER 1 in the Gulf of Mexico and the jack-up platform collapsed. One person was known dead and seven were missing on the 11th.

SMOOTH LOG, JUNE 1979--Most of the storms over Canada dissipated as they approached the Labrador Sea and Baffin Bay. The primary path of those storms that affected the mariner was northeastward along the east coast of the United States toward Kap Farvel and eastward across Iceland to the North Sea. The traffic was light. There were individual tracks across the water as far south as the Azores. Only those tracks across Canada and along the east coast of the United States closely followed the climatic paths.

The mean sea-level pressure pattern was not grossly different from climatology. The Icelandic Low had two 1007-mb centers, one between Kap Farvel and Iceland and the other over the Davis Strait. This compares to the two 1009-mb climatic centers near 60°N, 35°W, and Cape Chidley. The Azores High was larger than normal, with two 1025-mb centers near 40°N, 20°W, and 33°N, 46°W. The climatic center is 1024 mb near 33°N, 35°W. The eastern ridge stretched farther into Europe and the Mediterranean Sea than usual.

The anomaly analysis indicated that the pressure was greater than normal south of 60°N (using a gross approximation). The only significant area of negative values surrounded Greenland with the largest being 4 mb.

The upper air pattern at 700 mb closely resembled its climatic counterpart. The primary center of circulation was near the North Pole. A second center was over Baffin Bay. There was a short-wave trough off the U.S. East Coast, another west of the Azores, and the usual one over Portugal. Ridging over eastern Europe was more pronounced than normal.

Tropical storm Ana formed east of the Lesser Antilles.

Extratropical Cyclones--After the last storm in May dissipated north of the Azores during the first few days of this month, high pressure built in that area. A low-pressure center that left Nova Scotia on the 1st traveled southeastward, but it had little effect and was defeated by the HIGH. From the first week of the month through the second week the major part of the ocean was one large anticyclonic circulation with several small weak LOWs interspersed. During the last third of the month, larger LOWs developed and made greater inroads in the high pressure.

The first severe marine storm of the month formed with the combining of two low-pressure centers. On the 10th a frontal wave was over Ontario and another LOW was over northern Hudson Bay. On the 11th the northern LOW became the major center of circulation and intensified. At 1200 it was 972 mb near 64°N, 70°W. As the front moved off the U.S. East Coast the DART CANADA at 41°N, 65°W, found southerly 37-kn winds on the 12th at 0000. North of the 970-mb LOW, Cape Dyer and another weather station on the Baffin Bay coast of Baffin Island had northeasterly 35-kn gales. At 0600 the DISKO near 66°N, 54°W, had 37-kn winds from 160° and a pressure of 991 mb. At 1200 the KUNUNGUAK (64°N, 52°W) found 44-kn winds from 160° and 995 mb. Godthab on the coast measured 40-kn winds. The pressure was rising rapidly, and by midday on the 13th the LOW no longer existed.

As the LOW on the west coast of Greenland died, this one sprang into being off the east coast late on the 12th. At 1200 on the 13th the 993-mb LOW was over Iceland. At 1800 the ZIEMIA KRAKOWSKA was south of the Island at 57°N and reported 62-kn winds. There is a good possibility that the windspeed was doubled in decoding. On the 14th other ships in the area were reporting 35 to 40 kn. At 0600 the JOHN MURRAY (59°N, 11°W) radioed 40-kn winds with 20-ft seas and 25-ft swells. At 1200 the KRAKOWSKA repeated the high-wind report near 56°N, 22°W, this time with 20-ft seas and swells.

The storm was traveling southeastward and by 1200 on the 15th had moved over Germany.

On the 15th there was a large area of weak low pressure southeast of Newfoundland. The GRAND FELICITY (45°N, 53°W) had 38-kn winds. By midday on the 16th this had consolidated into one 1000-mb LOW near

42°N, 42°W. The TILLIE LYKES found 17-ft waves 200 mi southeast of the center. On the 17th the ZEALANDIC reported 23-ft waves near 46°N, 33°W. By the 18th the LOW had dissipated into a trough.

Weak frontal waves were traveling along a generally east-west front that lay across the Great Lakes. The ERNEST R. BREECH and CASON J. CALLAWAY were both on eastern Lake Superior with 35- to 40-kn winds. As one of the frontal waves moved over the Maritime Provinces it gained enough energy to continue to develop. At 1200 on the 19th the storm was 1000 mb at 49°N, 47°W. The ZAPATA RANGER was nearby with 37-kn southerly winds. At 1200 on the 20th the storm was near 54°N, 27°W, and turning more northeasterly. Three ships to the south had 12- to 15-ft waves. On the 21st the storm was moving toward the Shetland Islands. The BEN OCEAN LANCER was west of the center with 40-kn winds. Several ships had 14-ft waves. On the 22d OWS Lima measured 37-kn winds and 16-ft swell waves. Several other ships had winds and waves of the same strength. A few hours later a LOW over Iceland absorbed this one. Lima measured 40-kn winds and 23-ft swell waves with this LOW.

High pressure centered over the Great Lakes on the 25th brought record cold temperatures to many northeastern and central Atlantic U.S. cities on the morning of the 26th.

This LOW showed up on the 1200 analysis of the 26th east of Kap Farvel. Twelve hours later at 0000 on the 27th the HUDSON near 60°N, 50°W, had 35-kn winds. At 1200 the MINERAL HOBOKEN was sailing eastward along 50°N with 20-ft swell waves. As the storm moved over Iceland on the 28th, it treated several ships to 35- to 40-kn gales. One was Lima with 20-ft waves. Another was the MANCHESTER CONCORDE (56°N, 33°W) with 21-ft swells. The center of the storm moved against the Norwegian coast on the 30th and tracked northeastward along the coast until July 2, when it turned northwestward into the Greenland Sea. Jan Mayen measured 40-kn winds.

Tropical Cyclones--Ana was the first June storm to develop east of the Lesser Antilles since 1933 and only the second in 100 yr of record. Ana was earlier, but the 1933 storm developed farther to the east.

The disturbance which was to become Ana left the African west coast on the 14th. The first evidence of a tropical depression came on the morning of the 19th when satellite pictures showed that a circulation was developing near 10°N, 45°W. The depression moved west-northwestward at about 12 kn until late on the 20th, when it slowed and turned to the northwest. Some slight strengthening occurred at this time. Air Force reconnaissance reports indicated the depression was near tropical-storm strength late on the 21st.

Ana was named on the 22d, and gale warnings were issued for the islands from Martinique to Guadeloupe. However, strong westerlies at high levels began shearing the convection from the circulation center, and Ana reached the islands as a minimal tropical storm late that day. Continued weakening took place as the storm turned more to the west. Ana was downgraded to a tropical depression on the morning of June 23 and to a tropical wave in the central Caribbean the following day.

Maximum sustained winds in Ana were estimated to be 50 kn on the morning of the 22d with the minimum central pressure of 1005 mb also occurring at that time. There was no heavy rainfall in the islands and no reports of gale-force winds. No deaths or significant damage have been reported.

Casualties--The 104,000-ton American tanker BROOKLYN allegedly sustained heavy-weather damage on the 10th on a voyage Arabian Gulf to Curacao. The 16,033-ton Panamanian bulkcarrier GLORIOUS was in Rotterdam with heavy-weather damage from June 10 to 13. The 27,499-ton Liberian bulkcarrier ATLANTIC SEATRADE also suffered heavy-weather damage June 9 to 13.

The 14,245-ton Liberian REGAL SWORD and the 17,327-ton EXXON CHESTER (fig. 27) collided in fog off Cape Cod. The REGAL SWORD sank, but all the crew was rescued by the EXXON CHESTER. The 999-ton German tanker TARPENBEK collided with the British SIR GERAINT in fog on the 21st near 50.6°N, 00.9°W.

In another collision in fog off the west coast of Italy the 4,942-ton Italian tanker VERA BERLINGIERI and 12,202-ton French freighter EMMANUEL DELMAS both caught fire. Rescue ships picked up 23 of the 24 crewmembers of the Italian ship and 3 of the 30-man crew of the French ship. The VERA BERLINGIERI sank, and the EMMANUEL DELMAS was towed to Citavecchia Roads.

The 1,950-ton British-registered SHOREHAM ran aground on rocks at Mullion in fog on the 28th. On the 29th the 68,807-ton natural gas carrier EL PASO PAUL KAYSER ran aground in the Strait of Gibraltar in fog.

Figure 27.--The bow damage to the EXXON CHESTER is very apparent in this aerial photograph by the U.S. Coast Guard.

Smooth Log, North Pacific Weather

May and June 1979

SMOOTH LOG, MAY 1979--In contrast to the Atlantic the Pacific storm tracks followed climatology rather closely. The primary path was from south and east of Japan east-northeastward to the Gulf of Alaska. There was a swarm of storms over the Alaska Peninsula which climatology only hints at.

The mean sea-level pressure pattern differed from climatology mainly concerning the Aleutian Low. This month it was a 1002-mb center near Unimak Island versus three 1009-mb LOWs across the Bering Sea with the easterly one matching this month's single LOW. The Pacific High was the largest of all the features as usual. It was 1025 mb near 34°N, 140°W, which was 5° longitude east of its climatic 1023-mb position. There was the usual high pressure over the Arctic Ocean.

The only significant anomaly center was minus 9 mb near 52°N, 163°W. In general the pressure was lower than normal north of latitude 35°N and west of longitude 145°W.

The upper air pattern showed a LOW over the Fox Islands. This was southeast of and 57 m lower than its climatic position over the Bering Sea. The usual trough was over the Japan Sea and along the California coast with a ridge over Alaska and British Columbia.

Tropical storm Dot formed in the western North Pacific and hurricane Andres in the eastern ocean.

Extratropical Cyclones--This month's storms were relatively weak, and there did not appear to be as many as would be expected. On the 3d there was a LOW moving northward into the Gulf of Alaska, and another LOW formed to the south of it. A SHIP near 41°N, 169°W, had 45-kn winds as this new LOW tightened the pressure gradient. By 0000 on the 4th several ships were finding gales in the same relative position to the storm. Another SHIP at 35°N, 151°W, near the front claimed 68-kn winds and 16-ft waves. The PACIFIC ARROW (37°N, 152°W) and the RED ARROW (42°N, 153°W) both had 26-ft swell waves. The LOW was 990 mb on the 5th near 47°N, 138°W, and the SANKOSTAR had 40-kn gales. The MODOC near Cape Blanco measured 45-kn winds. On the 6th the storm stalled near Vancouver Island and dissipated on the 7th. This set up the northerly to northwesterly flow from the Pacific High along the coast again. On the 8th the AMERICA SUN and PACIFIC WING were near the coast between San Francisco and Portland with 35- to 40-kn winds and 18- to 20-ft waves.

This LOW was born on a stationary front between two large high-pressure cells of the Pacific High. On the 6th there were northeasterly winds on the northwestern side of the front and southwesterly winds on the southeastern side. This set up a cyclonic circulation, and an upper air short-wave trough triggered a frontal wave on the 7th. The western HIGH was pushing eastward, and the LOW raced northeastward around the eastern HIGH. On the 9th two ships had 40-kn winds near 39°N, 158°W, near the front. The PORTLAND (55°N, 144°W) and the SINCERE No. 3 (51°N, 136°W) both had 45-kn winds from the east and southeast, respectively. The THOMPSON PASS (53°N, 138°W) found 50-kn winds and 25-ft seas. The AMERICAN TRADER, not far from Point Sur, was still under the influence of northwesterly winds from the Pacific High and had 26-ft swells.

At 0000 on the 10th the LOW was 976 mb near 53°N, 145°W. OWS Papa had 50-kn westerly winds. The CGC SWEETBRIER was tossed by 26-ft waves, while the EXXON SAN FRANCISCO and PRINCE WILLIAM SOUND both had 45-kn winds near 54°N, 138°W. At 1200 the PORTLAND had a thunderstorm and 20-ft waves.

In 12 hr the pressure rose 23 mb as the storm moved over the Alaska coast. The storm still was pounding ships. At 1700 the PRINCE WILLIAM SOUND made a special observation with measured 45-kn winds, 18-ft seas, and giant 50-ft swells near 52°N, 138°W, or about 600 mi west of Seattle. By 0000 on the 11th the swells had decreased to 33 ft.

A trough was swinging southeastward over the Japan Sea on the 11th and by 1200 it was over Tokyo with a small LOW center. By 1200 on the 12th it was 986 mb near 41°N, 154°E. A ship about 450 mi to the southwest had 45-kn gales. On the 13th at the 0000 observation, 10 ships reported around the storm with 35- to 45-kn winds. The LEON PIERRE had 25-ft waves. At 0600 she had 55-kn winds and 20-ft waves. The GOLDEN GATE BRIDGE also found 55-kn winds near 38°N, 161°E, while a ship near 35°N, 155°E, had 33-ft swell waves.

At 0000 on the 14th this was a fairly large storm with an 800-mi radius at 986 mb. It was centered at 44°N, 173°E. A SHIP north of the center had 55-kn northeasterly winds. In the southwest quadrant a ship found 23-ft waves. A second LOW developed on the 16th and this one dissipated.

The STAR DIEPPE found 30-ft swell waves south of Unimak Pass on the 16th that continued into the 17th. The HONSHU GLORIA measured 47-kn winds in the same area.

This storm was exported from Shanghai on the 13th. By the time it was over Japan on the 14th it was a well-formed storm and brought gales to ships near and among the islands. The VAN ENTERPRISE was near the center with 72-kn southeasterly winds, 20-ft seas, and 39-ft swells at 0000 on the 15th. By 0600 the winds had decreased to 62 kn, but the swell waves were up to 49 ft. Two other ships in the same area reported 30-ft swell waves. For some undetermined reason, the storm suddenly filled and disappeared.

Monster of the Month--As the last storm suddenly disappeared this one formed near Hokkaido. The SEA-TRAIN VALLEY FORGE was east of Tokyo and measured 48-kn winds. The storm spread its area of influence, and by 0000 on the 18th it was 984 mb near

48°N, 152°E. There were reports of gale-force winds. The SEA-LAND COMMERCE was near 46°N, 157°E, at 1800 with 60-kn winds and 38-ft seas. At 0000 on the 19th the storm was 960 mb. The SANHO MARU (50°N, 179°E) had 46-kn winds with 21-ft seas. The SUGAR TRADER was less than 50 mi away with 54 kn and 23-ft waves. A few hours later the GENISTRA (49°N, 166°E) had 51-kn winds and 31-ft waves, while the MORI MARU (49°N, 171°E) had only 36-kn winds with 30-ft swells. Cold Bay, Alaska, measured gusts up to 42 kn.

On the 20th the 968-mb LOW was near 55°N, 178°W. The MIEKAWA MARU was southwest of the Near Islands with 45-kn winds and waves to 23 ft. Other ships were reporting gales and waves up to 26 ft. On the 21st a Korean ship not far from OWS Papa reported 48-kn winds. On the 22d the storm was weakening and on the 23d and 25th made an odd jump to the north before dissipating on the 26th.

Two Japanese ships can take credit for initially providing the observations that indicated the formation of this frontal wave on the 23d. Both had heavy rain with light winds, one from the east and the other from the south. The wave developed rapidly and was 994 mb near 42°N, 168°E, at 1200 on the 24th. A ship east of the center near the occlusion had 40-kn southerly winds. On the 25th the GOLDEN GATE BRIDGE had 47-kn winds and 15-ft waves. A ship in the southeast quadrant had 21-ft waves.

The AMERICAN RELIANCE (41°N, 174°E) and the EXPORT COURIER (41°N, 168°E) both had 40-kn winds southwest of the center, with the latter reporting 33-ft waves. On the 27th there were still gales and high waves near the same relative position to the LOW. The CARNATION found 33-ft swell waves and others 20 to 25 ft. The storm turned northward on the 27th and died on the 29th.

During these last few days of the month the Pacific High was fully entrenched off the California coast. Ships were finding the usual gale-force northerly winds and at times high waves.

Tropical Cyclones, Western Pacific--Dot developed west of Palau Island on the 10th. She moved west-northwestward across Mindanao and into the South China Sea before really developing. Late on the 13th after recurving back toward the Philippines, Dot reached tropical storm strength. This lasted for a few hours as she approached Manila. Once over Luzon Dot weakened rapidly. She hung on for a few more days, finally dissipating in the Philippine Sea on the 16th.

Tropical Cyclones, Eastern Pacific--Hurricane Andres began life in the waning hours of May some 300 mi south of the Gulf of Tehuantepec. Meandering aimlessly at first, Andres finally got his act together and headed north. On June 2 he reached tropical-storm strength. The following day Andres became a hurricane as he began turning northwestward to parallel the Mexican coastline about 50 mi south of Acapulco. By the 4th winds near his center were up to 80 kn with gusts to 90 kn. However, about midway between Acapulco and Manzanillo, Andres turned and rammed ashore, where he weakened rapidly.

Casualties--The British ACT 3 (23,818 tons) from St. John, N.B., to Wellington, New Zealand, reported heavy-weather damage on the 19th. The 19,907-ton British ISLAND PRINCESS was surveyed at Vancouver for heavy-weather damage incurred on the 27th.
Other Casualties--The 7,429-ton UNITED VANGUARD was abandoned May 12 near 10°N, 86°E, in cyclonic weather. One crewmember died. Vessel was last sighted May 23 near 13°N, 88°E, with a heavy list.

SMOOTH LOG, JUNE 1979--The storms tracked north and west of their climatological paths this month. The primary track was eastward across Hokkaido and then northeastward toward the Bering Sea. There was a secondary track from south of Adak Island to the Alaska Peninsula. The LOWs that reached the North American west coast originated over and south of the Gulf of Alaska. The climatological pattern shows the paths from the southern coast of Japan to near mid-ocean and then split toward the Bering Sea and into the Gulf of Alaska.

The mean sea-level pressure pattern gives an indication of the shift in the storm pattern. The Aleutian Low at 1006 mb was shifted to the Kamchatka Peninsula from north of Atka Island at 1010 mb. The Pacific High was much stronger than normal at 1031 mb versus 1024 mb, and it was also shifted westward to 40°N, 160°W, from 34°N, 145°W. There was a 1018-mb HIGH north of Bering Strait.

There were two significant anomaly centers. The largest was plus 13 mb near 43°N, 165°W, with its area of positive values covering most of the ocean to the north of latitude 20°N, except the northwestern corner. A minus 6-mb center was over the Kamchatka Peninsula. The zero isoline was an arc about the center with a radius of 700 to 800 mi.

The upper air pattern at 700 mb revealed the LOW was shifted westward to slightly east of the Kamchatka Peninsula in alinement with the surface LOW. The HIGH centered on 30°N was more intense than normal, and its maximum height also shifted westward. The anomalies were closely alined with their surface counterparts. The plus 117 m was near 44°N, 165°W, and the negative 48 m over central Kamchatka.

Tropical storm Blanca formed over the eastern ocean.

Extratropical Cyclones--The first third of the month the Pacific High was split into two centers, and LOWs and frontal waves were able to develop, especially to the north. The second third of the month the Pacific High was fully developed, averaging about 1040 mb

between 40° and 45°N and 150° and 160°W. It reached a maximum pressure of 1043 mb. Lows were kept well to the western and northwestern area of the basin. The last week of the month the High started breaking down, and a LOW moved to the Alaska Peninsula, as another formed off the North American coast and moved ashore near the Strait of Juan de Fuca. Storms that did form were weak even for a spring-summer month. Mostly they were noted for swell waves. A large number of the gale-force winds and high wave reports were associated with the northerly flow of the Pacific High.

On the 6th a small LOW was analyzed over the Gulf of Alaska. Its lifespan was about 12 hr. The Pacific High was pushing northward, and the MOBIL MERIDIAN near 51°N, 130°W, had 52-kn westerly winds. The High continued to push northeastward, and late on the 7th there were high-wind reports off the northern California coast. The EXXON PHILADELPHIA, JOHN TYLER, and the PACIFIC BEAR were among ships in the area. They reported 40- to 45-kn winds, seas up to 20 ft, and swells up to 30 ft. Gales continued through the 8th, but on the 9th a trough from the Mexican heat LOW relaxed and, therefore, so did the gradient.

The first significant storm of the month came out of the Sea of Japan on the 8th. On the 9th it was bringing gales to the area around 40°N, 155°E. The SEALAND FINANCE near 43°N, 152°E, had 35-kn winds and 18-ft waves. At 1200 the 990-mb LOW was near 46°N, 163°E. On the 10th a ship in the southerly flow reported gales with 16-ft seas and 20-ft swells.

The storm was now pushing against the developing Pacific High and reverted to a frontal wave and raced into the Bering Sea. Another LOW had formed at the point of occlusion and tried the southerly route around the HIGH for 24 hr, but it gave up on the 12th.

This storm also formed over the Sea of Japan on the 10th. On the 13th the 992-mb LOW was near 49°N, 158°E. The MYS KOURILSKII was east of Ostrop Urup with 37-kn westerly winds, while the island measured 35 kn. On the 14th a ship slightly farther east had 21-ft swell waves. By the 16th the storm was well into the Bering Sea with a relatively large but weak circulation. The HOHSING BREEZE was near Saint Paul Island with 39-kn winds and 20-ft seas and swells. On the 17th the storm was blowing out north of the Pribilof Islands, and a ship near the Rat Islands had 16-ft waves out of the southwest. The ATLANTIC PIONEER south of Unimak Island measured 35-kn winds and 15-ft seas.

The Kamchatka Peninsula was the birthplace of this low-pressure center. It moved northward the first 12 hr of the 20th, then southward for 12 hr. On the 22d the PRESIDENT KENNEDY was far south of the center along the front with 35-kn winds. The LUCID STAR was a few hundred miles east near 41°N, 179°W, with 39-kn southerly winds. The 5-ft waves they were reporting did match the windspeed very well. The CORAL ACE had showers of hail on the 23d with 18-ft swell waves.

The area north of Mongolia produced this LOW. It crossed the Sea of Okhotsk on the 23d. At 1200 of the 24th the 992-mb storm was near 47°N, 155°E. The BEISHU MARU was about 250 mi south of the center with 21-ft swell waves. On the 25th two ships near 51°N, 158°E, reported gales of 35 to 40 kn. The GOLDEN ORCHID found 40-kn winds east of the front near 45°N, 172°E, with 16-ft waves on the 26th. She was traveling northeastward at about the same speed as the weather system and on the 27th had 48-kn southerly winds very near the front. On the 28th a series of frontal waves moved eastward south of the weakening center, and it dissipated.

Monster of the Month--This was one of those frontal waves mentioned above. The wave that became this storm was indicated on the 0000 analysis of the 28th. By 0000 on the 29th it was south of Amchitka Island in the Aleutians. Both the MAPLE ACE (48°N, 176°W) and the SHIMA MARU (45°N, 177°W) were east of the front with southerly gales between 35 and 40 kn. Both were reporting 13-ft waves.

Another frontal wave was following this one, and the ZENKOREN MARU found 16-ft swell waves south of it. This frontal wave was moving around the periphery of the larger one. The NEPTUNE TOPAZ at 40°N, 175°W, was south of both centers at 0000 on the 30th with 45-kn winds from the southeast and 30-ft swell waves from the southwest. At 0600 her winds had relaxed to 40 kn and the waves to 20 ft. A Japanese ship at 44°N, 171°W, had picked up the 45-kn winds.

The storm turned westward, then northward, and died over the Bering Sea.

Continuing frontal waves on the east-west-oriented front brought torrential rains to Japan for 5 days prior to July 1. At least 23 people died, with 5 missing, 50 injured, and 28,000 left homeless in the downpour. The Meteorological Agency said that up to 1,200 mm (47 in) fell in mountainous areas of southern Japan. The heavy rains triggered 1,700 landslides, washed out 28 bridges, and rivers broke their banks in 70 places.

Tropical Cyclones, Eastern Pacific--Tropical storm Blanca developed on the 20th, becoming the second named tropical cyclone. Blanca moved west-northwestward along the 10th parallel, passing south of Clipperton Island on the 22d. Her winds were at a maximum of 45 kn at this time. By the 24th she had crossed the 115th meridian and was starting to weaken. The following day she fell to depression strength.

Casualties--The 42,446-ton Liberian-registered ALCYONE was at Kobe on the 5th with heavy-weather

Continued on page 423.

Principal Tracks of Centers of Cyclones at Sea Level, North Atlantic

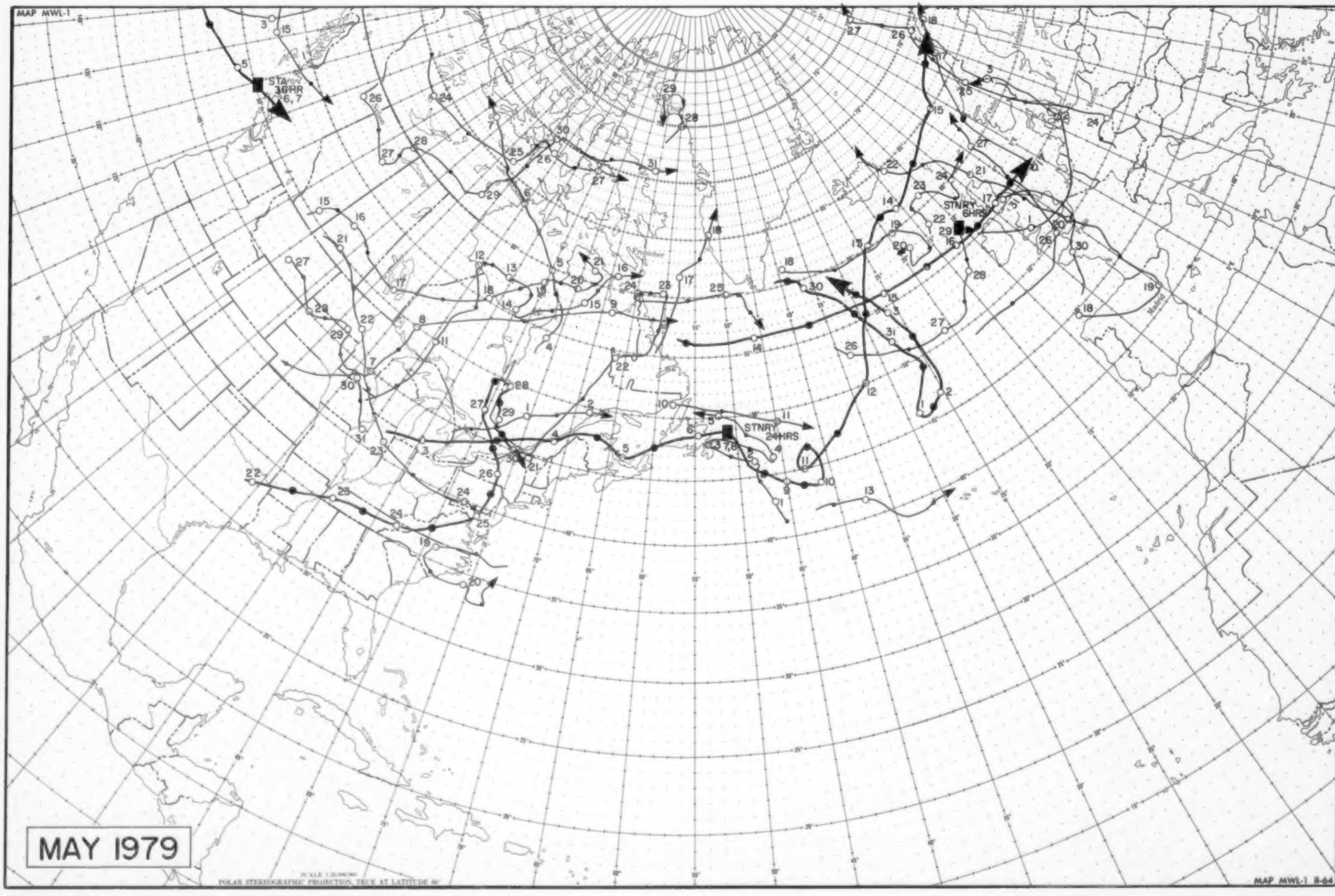


Figure 28.--Open circle indicates 1200 GMT position and closed circle 0000 GMT position. Square indicates stationary center. Cyclone tracks marked with a heavy line are described in the Smooth Log.

Principal Tracks of Centers of Cyclones at Sea Level, North Atlantic

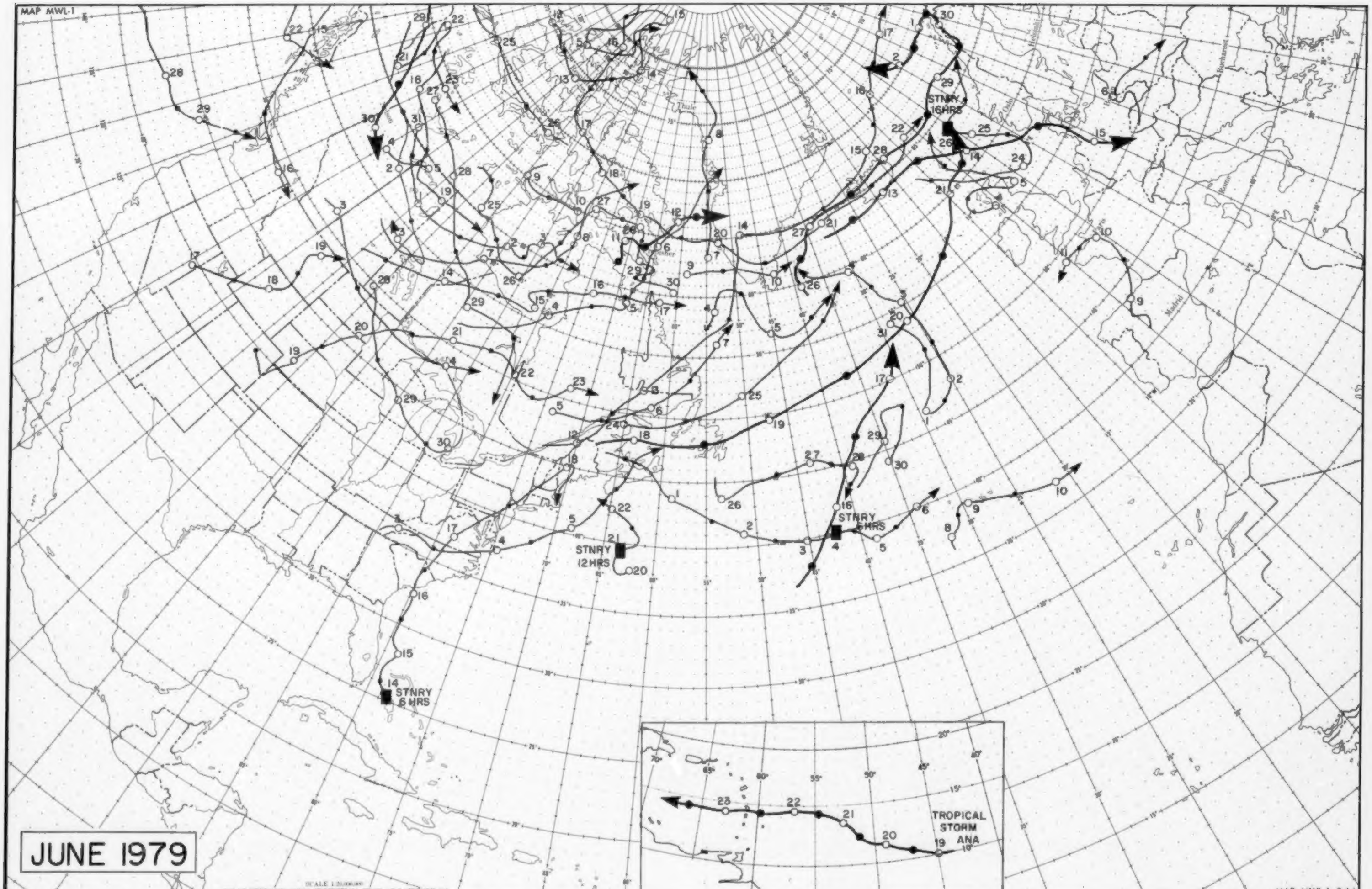


Figure 29.--Open circle indicates 1200 GMT position and closed circle 0000 GMT position. Square indicates stationary center. Cyclone tracks marked with a heavy line are described in the Smooth Log.

Principal Tracks of Centers of Cyclones at Sea Level, North Pacific

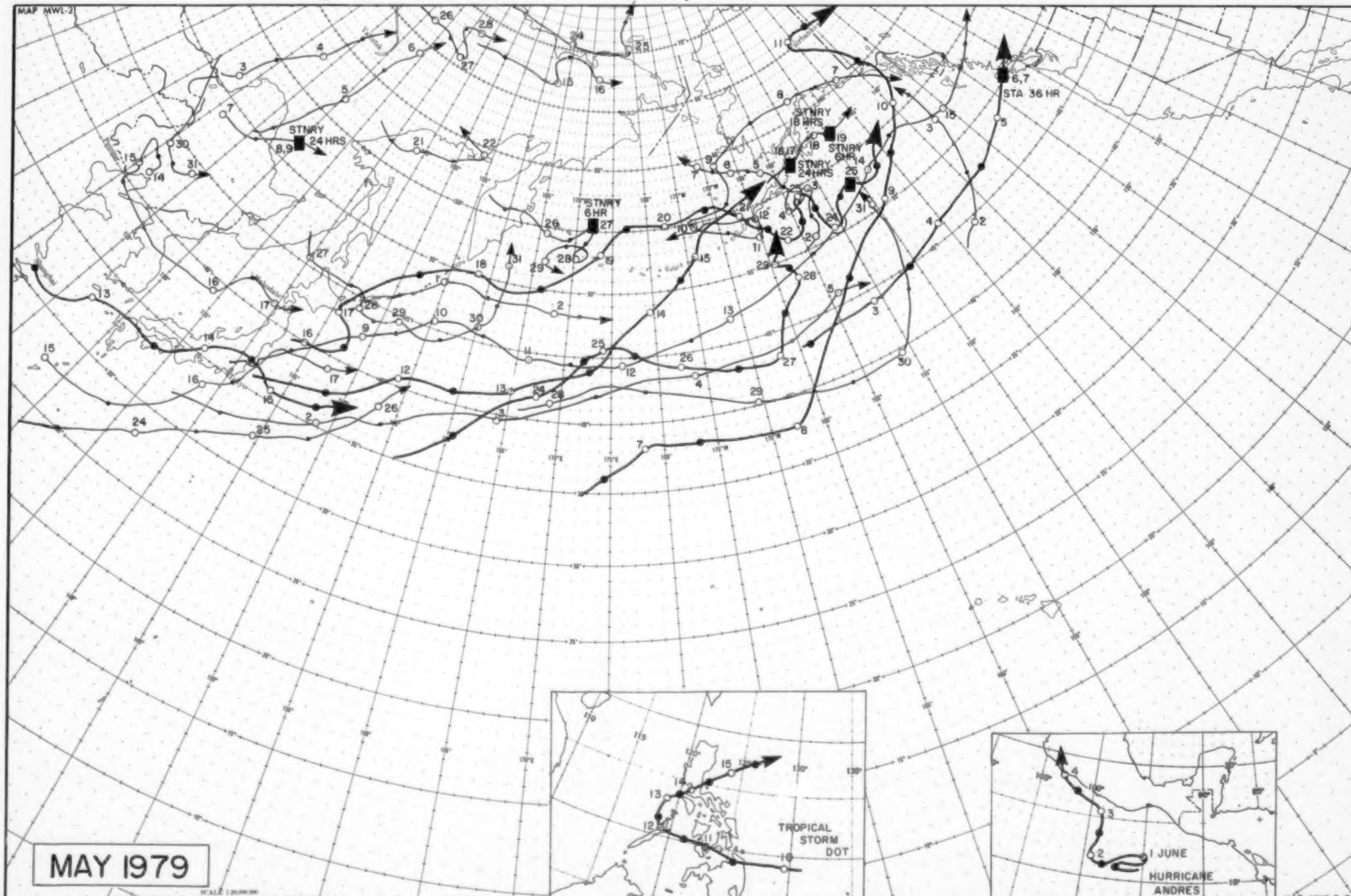


Figure 30.--Open circle indicates 1200 GMT position and closed circle 0000 GMT position. Square indicates stationary center. Cyclone tracks marked with a heavy line are described in the Smooth Log.

Principal Tracks of Centers of Cyclones at Sea Level, North Pacific

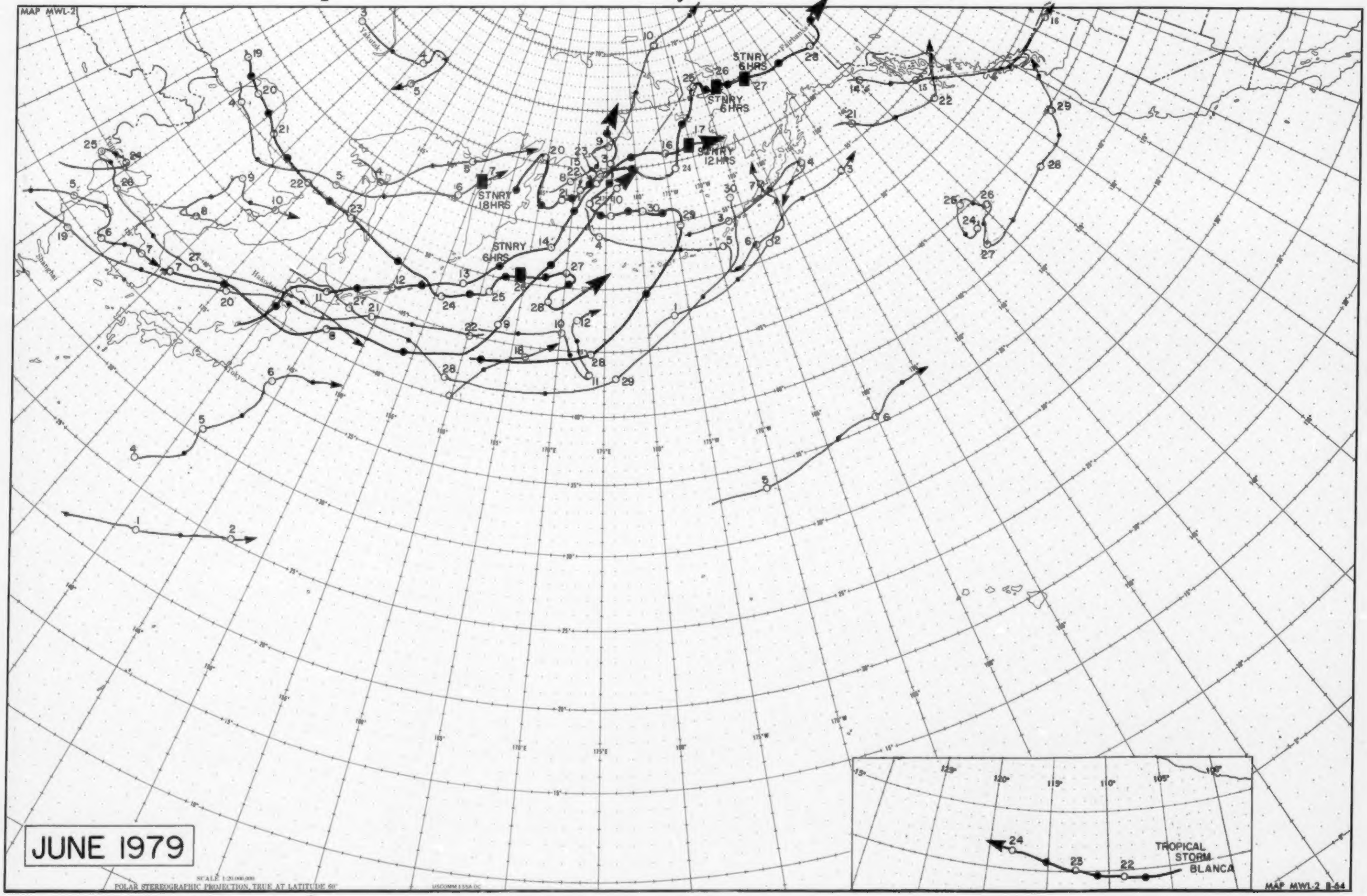


Figure 31.--Open circle indicates 1200 GMT position and closed circle 0000 GMT position. Square indicates stationary center. Cyclone tracks marked with a heavy line are described in the Smooth Log.

Table 8
U.S. Ocean Buoy Climatological Data

May and June 1979

MAY — DATA SUMMARY — 41002

AVERAGE LATITUDE 32.3N — AVERAGE LONGITUDE 075.3W

MEANS AND EXTREMES

	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	18.9	(17 12)	21.9	24.4	(30 21)	237	31
SEA TEMP (DEG C)	21.0	(05 12)	22.6	24.4	(19 21)	237	31
AIR-SEA TEMP (DEG C)	-04.1	(26 18)	-00.7	00.7	(30 15)	237	31
PRESSURE (MBAR)	1006.8	(25 12)	1018.2	1025.3	(31 15)	238	31

WIND - % FREQUENCIES, MEANS AND EXTREMES — NO. OF OBS: 241

DIR	<4	4-10	11-21	22-33	34-47	>47	TOTAL %	MEAN SPEED (KNOTS)
N	.8	2.1	.4				3.3	5.5
NE	.4	2.1	3.7				6.2	12.1
E	.4	.8	5.4	.8			7.5	14.7
SE	.8	2.9	10.4				14.1	12.0
S	.4	9.5	22.8	1.7			34.4	13.1
SW	1.2	6.6	13.3	1.2			22.4	12.7
W	1.2	3.3	3.7				8.3	11.4
NW	.4	2.5	.4				3.3	6.9
CALM	.4						.4	.0
TOTAL	6.2	29.9	60.2	3.7			100.0	12.3

MAX WIND — SPEED: 28 KNOTS; DIRECTION: 210 DEG; DAY: 25; HOUR: 12

JUNE — DATA SUMMARY — 41002

AVERAGE LATITUDE 32.3N — AVERAGE LONGITUDE 075.3W

MEANS AND EXTREMES

	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	21.6	(12 09)	23.8	26.0	(03 21)	237	30
SEA TEMP (DEG C)	23.0	(15 21)	24.8	26.8	(22 18)	237	30
AIR-SEA TEMP (DEG C)	-03.6	(27 06)	-00.8	01.0	(17 00)	237	30
PRESSURE (MBAR)	1008.3	(05 00)	1019.0	1025.4	(21 15)	237	30

WIND - % FREQUENCIES, MEANS AND EXTREMES — NO. OF OBS: 237

DIR	<4	4-10	11-21	22-33	34-47	>47	TOTAL %	MEAN SPEED (KNOTS)
N		3.0	.4				3.4	8.6
NE	2.1	5.1	8.0	.8			16.0	11.8
E	.8	3.8	12.2	10.5			27.4	17.0
SE	1.7	3.8	2.5				8.0	8.8
S	1.3	.8	4.6				6.8	10.0
SW		11.4	13.1				24.5	11.2
W		7.6	1.7				9.3	8.8
NW	1.7	1.7	.4				3.8	4.8
CALM	.8						.8	.0
TOTAL	8.4	37.1	43.0	11.4			100.0	12.0

MAX WIND — SPEED: 25 KNOTS; DIRECTION: 080 DEG; DAY: 15; HOUR: 12

MAY — DATA SUMMARY — 41004

AVERAGE LATITUDE 32.6N — AVERAGE LONGITUDE 078.7W

MEANS AND EXTREMES

	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	15.7	(26 08)	22.4	25.9	(22 21)	238	31
SEA TEMP (DEG C)	21.2	(02 12)	23.1	25.7	(22 21)	240	31
AIR-SEA TEMP (DEG C)	-08.9	(26 08)	-00.7	01.6	(24 21)	238	31
PRESSURE (MBAR)	1005.9	(25 08)	1017.5	1024.0	(17 18)	241	31

WIND - % FREQUENCIES, MEANS AND EXTREMES — NO. OF OBS: 242

DIR	<4	4-10	11-21	22-33	34-47	>47	TOTAL %	MEAN SPEED (KNOTS)
N	.4	4.1	2.5	.8			7.8	10.8
NE	.4	2.9	10.7	1.2			15.3	14.4
E	1.2	2.1	6.2				9.5	11.2
SE	.8	5.8	4.5				11.2	10.4
S	.4	8.3	12.4	1.2			22.3	12.3
SW		6.6	12.4	1.2			20.2	12.4
W	.4	4.1	5.8	1.7			12.0	13.6
NW	.4	.4	.4				1.2	8.7
CALM	.4						.4	.0
TOTAL	4.5	34.3	55.0	6.2			100.0	12.3

MAX WIND — SPEED: 26 KNOTS; DIRECTION: 030 DEG; DAY: 17; HOUR: 15

JUNE — DATA SUMMARY — 41004

AVERAGE LATITUDE 32.6N — AVERAGE LONGITUDE 078.7W

MEANS AND EXTREMES

	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	20.6	(17 08)	24.2	28.4	(18 18)	238	30
SEA TEMP (DEG C)	23.4	(01 06)	25.0	27.5	(30 03)	238	30
AIR-SEA TEMP (DEG C)	-04.3	(12 00)	-00.7	01.5	(16 15)	238	30
PRESSURE (MBAR)	1008.6	(04 21)	1018.9	1026.3	(21 03)	238	30

WIND - % FREQUENCIES, MEANS AND EXTREMES — NO. OF OBS: 238

DIR	<4	4-10	11-21	22-33	34-47	>47	TOTAL %	MEAN SPEED (KNOTS)
N	.8		3.3	.4			4.6	14.8
NE	.8	3.3	9.2	9.6			23.0	17.5
E		5.9	11.7	6.7			24.3	16.0
SE		3.3	2.5				5.8	10.0
S	.8	3.3	1.3	.4			5.8	10.1
SW	2.5	3.8	13.0	.4			19.7	11.2
W	.8	4.2	9.2	.8			15.1	11.7
NW	.4	1.3					1.7	5.0
CALM								
TOTAL	6.3	25.1	50.2	18.4			100.0	13.8

MAX WIND — SPEED: 28 KNOTS; DIRECTION: 060 DEG; DAY: 27; HOUR: 00

MAY — DATA SUMMARY — 41005

AVERAGE LATITUDE 31.7N — AVERAGE LONGITUDE 078.7W

MEANS AND EXTREMES

	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	17.1	(26 06)	22.8	25.4	(24 06)	246	31
SEA TEMP (DEG C)	20.6	(06 08)	23.4	26.6	(20 21)	246	31
AIR-SEA TEMP (DEG C)	-05.3	(26 06)	-00.7	02.5	(07 06)	246	31
PRESSURE (MBAR)	1006.5	(25 08)	1016.4	1022.6	(17 15)	246	31

WIND - % FREQUENCIES, MEANS AND EXTREMES — NO. OF OBS: 246

DIR	<4	4-10	11-21	22-33	34-47	>47	TOTAL %	MEAN SPEED (KNOTS)
N	.4	2.4	3.3				6.1	12.3
NE		2.4	8.5	2.0			13.0	15.7
E		1.2	2.4				3.7	13.6
SE	1.2	3.7	7.3	.4			12.6	12.4
S	.4	6.5	15.4	.8			23.2	12.7
SW	.8	10.6	11.0	.4			22.8	11.5
W	.8	5.3	4.5	.4			11.0	11.4
NW	.4		1.2	1.6			3.3	10.8
CALM	4.5						4.5	.0
TOTAL	8.5	32.1	53.7	5.7			100.0	12.3

MAX WIND — SPEED: 25 KNOTS; DIRECTION: 300 DEG; DAY: 26; HOUR: 06

JUNE — DATA SUMMARY — 41005

AVERAGE LATITUDE 31.7N — AVERAGE LONGITUDE 078.7W

MEANS AND EXTREMES

	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	20.8	(12 03)	24.8	28.4	(18 21)	238	30
SEA TEMP (DEG C)	23.1	(01 12)	25.9	28.0	(24 00)	238	30
AIR-SEA TEMP (DEG C)	-06.1	(12 03)	-01.0	01.7	(01 00)	238	30
PRESSURE (MBAR)	1008.3	(16 08)	1017.7	1025.0	(20 15)	238	30

WIND - % FREQUENCIES, MEANS AND EXTREMES — NO. OF OBS: 238

DIR	<4	4-10	11-21	22-33	34-47	>47	TOTAL %	MEAN SPEED (KNOTS)
N		2.5	.8				3.3	8.2
NE	.4	3.8	11.3	13.4			28.8	18.3
E	.4	5.0	6.7	2.1			14.2	12.8
SE		4.2	1.7	.4			6.3	10.6
S	.4	2.5	3.8	.4			7.1	11.1
SW	1.3	8.8	7.1	.4			17.6	10.3
W		8.4	10.0	.4			18.8	11.8
NW	.8	.4	1.3				2.5	8.5
CALM	1.3						1.3	.0
TOTAL	4.6	35.6	42.7	17.2			100.0	13.4

MAX WIND — SPEED: 28 KNOTS; DIRECTION: 130 DEG; DAY: 16; HOUR: 08

MAY — DATA SUMMARY — 42001

AVERAGE LATITUDE 26.0N — AVERAGE LONGITUDE 090.0W

MEANS AND EXTREMES

	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	22.2	(26 09)	25.3	27.4	(12 21)	248	31
SEA TEMP (DEG C)	22.9	(08 21)	25.6	27.8	(12 21)	243	31
AIR-SEA TEMP (DEG C)	-04.0	(26 09)	-00.3	02.3	(11 09)	243	31
PRESSURE (MBAR)	1008.1	(09 09)	1014.3	1018.6	(15 15)	248	31

WIND - % FREQUENCIES, MEANS AND EXTREMES — NO. OF OBS: 248

DIR	<4	4-10	11-21	22-33	34-47	>47	TOTAL %	MEAN SPEED (KNOTS)
N	.8	3.2	1.2				5.2	8.5
NE		.8	7.7				8.5	14.0
E		15.3	14.9				30.2	11.2
SE		12.1	9.7				21.8	10.6
S		7.7	22.2				29.8	13.0
SW		.4	.8				1.2	14.7
W			.4				.4	18.0
NW	.4	.8	1.2				2.4	8.5
CALM	.4						.4	.0
TOTAL	1.6	40.3	58.1				100.0	11.7

MAX WIND — SPEED: 21 KNOTS; DIRECTION: 090 DEG; DAY: 17; HOUR: 03

WAVES - % FREQUENCIES, MEAN AND EXTREME (METERS) — NO. OF WAVE OBS: 247

HEIGHT (M)	<1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	MEAN	MAX	(DA HR)
% FREQUENCY	12.6	81.4	6.1						1.2M	2.5M	(04 12)

JUNE — DATA SUMMARY — 42001

AVERAGE LATITUDE 26.0N — AVERAGE LONGITUDE 090.0W

MEANS AND EXTREMES

	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	23.5	(15 18)	27.2	28.7	(05 00)	238	30
SEA TEMP (DEG C)	26.2	(21 08)	27.5	29.2	(05 00)	237	30
AIR-SEA TEMP (DEG C)	-03.4	(15 18)	-00.3	01.2	(21 08)	237	30
PRESSURE (MBAR)	1010.7	(06 00)	1016.8	1021.7	(26 18)	238	30

WIND - % FREQUENCIES, MEANS AND EXTREMES — NO. OF OBS: 238

DIR	<4	4-10	11-21	22-33	34-47	>47	TOTAL %	MEAN SPEED (KNOTS)
N		.4					.4	6.0
NE		5.0	5.8				10.8	11.2
E	1.3	21.0	15.5				37.8	9.9
SE	2.5	16.0	15.1				33.6	9.2
S	2.5	7.6	5.0				15.1	8.3
SW								
W								
NW	.4						.4	3.0
CALM	1.7						1.7	.0
TOTAL	8.4	50.0	41.6				100.0	9.3

MAX WIND — SPEED: 21 KNOTS; DIRECTION: 040 DEG; DAY: 15; HOUR: 18

WAVES - % FREQUENCIES, MEAN AND EXTREME (METERS) — NO. OF WAVE OBS: 235

HEIGHT (M)	<1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	MEAN	MAX	(DA HR)
% FREQUENCY	40.4	57.0	2.6						.8M	2.0M	(15 18)

MAY — DATA SUMMARY — 42002

AVERAGE LATITUDE 26.0N — AVERAGE LONGITUDE 093.5W

MEANS AND EXTREMES

	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	20.1	(08 12)	24.5	28.8	(30 21)	248	31
SEA TEMP (DEG C)	23.0	(08 15)	24.7	26.8	(07 21)	248	31
AIR-SEA TEMP (DEG C)	-04.5	(31 12)	-00.2	01.5	(12 15)	248	31
PRESSURE (MBAR)	1005.7	(10 00)	1013.8	1021.0	(15 15)	248	31

WIND - % FREQUENCIES, MEANS AND EXTREMES — NO. OF OBS: 248

DIR	<4	4-10	11-21	22-33	34-47	>47	TOTAL %	MEAN SPEED (KNOTS)
N	.4	3.6	10.5	1.2	.4		16.1	14.0
NE	.4	2.8	7.3	.8			11.3	12.2
E	1.2	7.3	16.1	.4			25.0	11.1
SE		12.5	25.8	1.2			39.5	13.6
S	.4	1.6	3.2				5.2	12.7
SW		1.2					1.2	5.3
W	.4	.4					.8	4.1
NW		.8					.8	6.5
CALM								
TOTAL	2.8	30.2	62.8	3.6	.4		100.0	12.6

MAX WIND — SPEED: 35 KNOTS; DIRECTION: 020 DEG; DAY: 04; HOUR: 21

JUNE — DATA SUMMARY — 42002

AVERAGE LATITUDE 26.0N — AVERAGE LONGITUDE 093.5W

MEANS AND EXTREMES

	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	25.0	(13 09)	27.1	28.6	(30 18)	238	30
SEA TEMP (DEG C)	26.4	(01 12)	27.6	30.6	(30 18)	238	30
AIR-SEA TEMP (DEG C)	-01.8	(13 09)	-00.5	00.5	(24 00)	238	30
PRESSURE (MBAR)	1008.6	(08 00)	1016.8	1022.4	(26 18)	238	30

WIND - % FREQUENCIES, MEANS AND EXTREMES — NO. OF OBS: 238

DIR	<4	4-10	11-21	22-33	34-47	>47	TOTAL %	MEAN SPEED (KNOTS)
N		1.7	2.9				4.6	13.4
NE	1.3	8.0	9.2				18.5	10.5
E	1.3	18.5	8.0				27.7	9.2
SE	2.1	19.3	25.2				46.6	11.6
S		1.3	.8				2.1	8.8
SW								
W	.4						.4	2.0
NW								
CALM								
TOTAL	5.0	48.7	46.2				100.0	10.8

MAX WIND — SPEED: 20 KNOTS; DIRECTION: 020 DEG; DAY: 12; HOUR: 03

MAY DATA SUMMARY 42003

AVERAGE LATITUDE 26.0N AVERAGE LONGITUDE 086.0W

MEANS AND EXTREMES	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	21.8	(26 09)	25.3	27.5	(31 18)	212	30
SEA TEMP (DEG C)	25.2	(02 12)	27.0	28.3	(14 21)	212	30
AIR-SEA TEMP (DEG C)	-05.5	(26 09)	-01.8	00.2	(10 15)	212	30
PRESSURE (MBAR)	1008.8	(08 09)	1015.2	1020.6	(18 15)	212	30

WIND - % FREQUENCIES, MEANS AND EXTREMES

NO. OF OBS: 212

DIR	<4	4-10	11-21	22-33	34-47	>47	TOTAL %	MEAN SPEED (KNOTS)
N		.8	2.4				3.3	12.6
NE	.8	2.4	15.1				18.4	13.8
E		11.8	23.1	1.4			36.3	12.2
SE		5.2	19.8				25.0	13.0
S	.5	2.4	7.5	.8			11.3	13.5
SW		.8	1.4				2.4	11.8
W			.5				.5	13.1
NW			2.8				2.8	12.3
CALM								
TOTAL	1.4	23.8	72.8	2.4			100.0	12.8

MAX WIND
SPEED: 30 KNOTS
DIRECTION: 070 DEG
DAY: 07
HOUR: 03

WAVES - % FREQUENCIES, MEAN AND EXTREME (METERS) NO. OF WAVE OBS: 211

HEIGHT (M)	<1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	MEAN	MAX	(DA HR)
% FREQUENCY	23.7	66.8	8.5	.9					1.1M	3.0M	(07 12)

MAY DATA SUMMARY 42005

AVERAGE LATITUDE 30.0N AVERAGE LONGITUDE 085.9W

MEANS AND EXTREMES	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	16.2	(25 09)	23.8	26.7	(15 21)	243	31
SEA TEMP (DEG C)	21.2	(02 12)	23.6	25.4	(10 21)	243	31
AIR-SEA TEMP (DEG C)	-05.8	(25 09)	-00.8	02.3	(15 21)	243	31
PRESSURE (MBAR)	1009.1	(08 09)	1016.1	1023.0	(18 16)	243	31

WIND - % FREQUENCIES, MEANS AND EXTREMES

NO. OF OBS: 243

DIR	<4	4-10	11-21	22-33	34-47	>47	TOTAL %	MEAN SPEED (KNOTS)
N		3.3	6.6	.4			10.3	12.5
NE		1.2	2.1	.8			4.1	15.0
E		5.3	6.2	.4			11.8	12.2
SE	.8	7.8	12.8				21.4	11.4
S	.8	11.8	6.2	.8			19.8	8.3
SW		8.8	3.7	.4			12.8	8.3
W	1.2	5.8	5.3	.4			12.8	9.2
NW	.8	2.5	2.9	.4			6.6	11.8
CALM	.4						.4	.0
TOTAL	4.1	48.5	45.7	3.7			100.0	10.8

MAX WIND
SPEED: 25 KNOTS
DIRECTION: 070 DEG
DAY: 08
HOUR: 03

MAY DATA SUMMARY 44001

AVERAGE LATITUDE 38.7N AVERAGE LONGITUDE 073.6W

MEANS AND EXTREMES	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	08.1	(02 12)	13.6	17.6	(24 15)	238	31
SEA TEMP (DEG C)	08.6	(01 08)	12.2	15.5	(17 08)	238	31
AIR-SEA TEMP (DEG C)	-01.0	(16 12)	01.4	04.5	(24 15)	238	31
PRESSURE (MBAR)	1001.4	(25 21)	1016.3	1025.6	(02 12)	238	31

WIND - % FREQUENCIES, MEANS AND EXTREMES

NO. OF OBS: 238

DIR	<4	4-10	11-21	22-33	34-47	>47	TOTAL %	MEAN SPEED (KNOTS)
N	.8	4.2	2.1				7.1	8.7
NE	2.1	4.6	4.2	.8			11.8	10.9
E	2.5	2.1	2.9				7.6	8.2
SE	.4	1.7	.8				2.9	7.6
S	1.7	7.1	8.8	.4			18.1	10.3
SW	1.7	16.0	14.7	.4			32.8	10.9
W	1.7	5.8	5.5				13.0	8.1
NW	.4	3.8					4.2	6.0
CALM	2.5						2.5	.0
TOTAL	13.8	45.4	38.1	1.7			100.0	9.5

MAX WIND
SPEED: 24 KNOTS
DIRECTION: 040 DEG
DAY: 17
HOUR: 15

MAY DATA SUMMARY 44002

AVERAGE LATITUDE 40.1N AVERAGE LONGITUDE 073.0W

MEANS AND EXTREMES	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	08.4	(02 12)	12.6	18.0	(31 08)	248	31
SEA TEMP (DEG C)	07.8	(01 06)	11.4	15.1	(31 21)	248	31
AIR-SEA TEMP (DEG C)	-01.0	(28 18)	01.2	03.3	(10 03)	248	31
PRESSURE (MBAR)	1002.5	(25 12)	1016.2	1026.5	(17 18)	248	31

WIND - % FREQUENCIES, MEANS AND EXTREMES

NO. OF OBS: 248

DIR	<4	4-10	11-21	22-33	34-47	>47	TOTAL %	MEAN SPEED (KNOTS)
N	.4	4.0	1.6				6.0	9.1
NE	.8	3.2	3.6				7.7	10.8
E	.8	6.5	7.7				14.9	11.4
SE	1.2	1.6	1.2				4.0	6.0
S	2.0	4.8	10.1				16.9	10.9
SW	.8	16.1	15.7				32.7	10.5
W	.8	8.9	3.6				13.3	8.0
NW	1.2	2.4	.4				4.0	6.3
CALM	.4						.4	.0
TOTAL	8.5	47.6	44.0				100.0	9.8

MAX WIND
SPEED: 21 KNOTS
DIRECTION: 070 DEG
DAY: 19
HOUR: 03

MAY DATA SUMMARY 44003

AVERAGE LATITUDE 40.8N AVERAGE LONGITUDE 068.5W

MEANS AND EXTREMES	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	05.2	(02 09)	10.0	15.4	(30 08)	238	31
SEA TEMP (DEG C)	06.0	(01 09)	07.6	10.2	(21 00)	238	31
AIR-SEA TEMP (DEG C)	-00.9	(02 09)	02.4	06.6	(30 08)	238	31
PRESSURE (MBAR)	1002.7	(05 09)	1017.8	1025.4	(18 12)	238	31

WIND - % FREQUENCIES, MEANS AND EXTREMES

NO. OF OBS: 238

DIR	<4	4-10	11-21	22-33	34-47	>47	TOTAL %	MEAN SPEED (KNOTS)
N	1.3	.4	.8				2.5	6.0
NE	.4	4.2	2.1				6.7	8.8
E	.8	8.8	7.1				16.8	9.2
SE		10.9	5.0				16.0	9.2
S	2.1	12.6	8.4				23.1	9.1
SW	.4	9.7	2.5				12.6	8.0
W	1.7	13.9	2.1				17.6	7.4
NW	.8	2.1	1.3				4.2	8.0
CALM	.4						.4	.0
TOTAL	8.0	62.6	29.4				100.0	8.5

MAX WIND
SPEED: 18 KNOTS
DIRECTION: 220 DEG
DAY: 14
HOUR: 08

WAVES - % FREQUENCIES, MEAN AND EXTREME (METERS) NO. OF WAVE OBS: 226

HEIGHT (M)	<1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	MEAN	MAX	(DA HR)
% FREQUENCY	15.0	69.9	12.8	2.2					1.3M	3.5M	(26 08)

MAY DATA SUMMARY 44004

AVERAGE LATITUDE 38.0N AVERAGE LONGITUDE 070.0W

MEANS AND EXTREMES	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	11.5	(02 15)	18.6	22.0	(23 21)	247	31
SEA TEMP (DEG C)	15.6	(24 15)	18.8	21.2	(18 08)	247	31
AIR-SEA TEMP (DEG C)	-08.0	(02 15)	-00.3	04.7	(24 18)	247	31
PRESSURE (MBAR)	1005.1	(05 09)	1018.1	1024.4	(08 15)	247	31

WAVES - % FREQUENCIES, MEAN AND EXTREME (METERS) NO. OF WAVE OBS: 247

HEIGHT (M)	<1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	MEAN	MAX	(DA HR)
% FREQUENCY	16.6	68.0	13.0	2.4					1.3M	3.0M	(28 12)

JUNE DATA SUMMARY 42003

AVERAGE LATITUDE 26.0N AVERAGE LONGITUDE 086.0W

MEANS AND EXTREMES	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	22.0	(15 12)	27.1	29.2	(30 21)	223	30
SEA TEMP (DEG C)	27.4	(23 15)	28.4	30.2	(30 21)	224	30
AIR-SEA TEMP (DEG C)	-05.6	(15 12)	-01.3	00.4	(23 18)	223	30
PRESSURE (MBAR)	1012.1	(06 00)	1017.2	1021.8	(20 15)	224	30

WIND - % FREQUENCIES, MEANS AND EXTREMES

NO. OF OBS: 223

DIR	<4	4-10	11-21	22-33	34-47	>47	TOTAL %	MEAN SPEED (KNOTS)
N	1.8	4.5	1.3				7.6	8.7
NE	1.8	8.0	20.2				30.8	12.3
E	1.3	26.5	18.8				46.6	10.0
SE	1.3	4.9	.4				6.7	7.1
S	2.7	.4	.4				3.6	3.3
SW	.4	.4					.8	2.5
W	.9						.9	2.1
NW	1.3	.4					1.8	3.5
CALM	.9						.9	.0
TOTAL	12.6	46.2	41.3				100.0	9.7

MAX WIND
SPEED: 20 KNOTS
DIRECTION: 060 DEG
DAY: 15
HOUR: 00

WAVES - % FREQUENCIES, MEAN AND EXTREME (METERS) NO. OF WAVE OBS: 226

HEIGHT (M)	<1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	MEAN	MAX	(DA HR)
% FREQUENCY	54.8	43.4	1.8						.8M	2.0M	(19 12)

JUNE DATA SUMMARY 42005

AVERAGE LATITUDE 30.0N AVERAGE LONGITUDE 085.9W

MEANS AND EXTREMES	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	21.3	(18 12)	25.8	28.1	(20 21)	238	30
SEA TEMP (DEG C)	24.6	(01 12)	26.8	28.8	(09 18)	238	30
AIR-SEA TEMP (DEG C)	-04.8	(27 12)	-01.0	01.4	(20 21)	238	30
PRESSURE (MBAR)	1011.1	(05 00)	1017.8	1022.8	(21 18)	238	30

WIND - % FREQUENCIES, MEANS AND EXTREMES

NO. OF OBS: 238

DIR	<4	4-10	11-21	22-33	34-47	>47	TOTAL %	MEAN SPEED (KNOTS)
N	1.7	2.9	2.9	.8			8.4	10.3
NE	.4	4.2	11.3	1.3			17.2	14.6
E	.4	4.2	6.7				11.3	11.2
SE	1.7	2.5	.8				5.0	6.3
S	1.3	10.0	1.3				12.6	7.2
SW	1.3	13.4	7.1				21.8	8.9
W	1.3	11.3	5.4				18.0	8.8
NW		3.8	.8				4.6	8.1
CALM	1.3						1.3	.0
TOTAL	8.2	52.3	38.4	2.1			100.0	8.7

MAX WIND
SPEED: 23 KNOTS
DIRECTION: 360 DEG
DAY: 12
HOUR: 06

JUNE DATA SUMMARY 44001

AVERAGE LATITUDE 38.7N AVERAGE LONGITUDE 073.6W

MEANS AND EXTREMES	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	13.9	(12 12)	18.2	21.3	(30 21)	239	30
SEA TEMP (DEG C)	14.5	(05 12)	17.9	20.7	(08 21)	239	30
AIR-SEA TEMP (DEG C)	-03.3	(24 21)	00.3	02.4	(03 18)	239	30
PRESSURE (MBAR)	1006.1	(05 03)	1018.8	1031.7	(28 21)	239	30

WIND - % FREQUENCIES, MEANS AND EXTREMES

NO. OF OBS: 239

DIR	<4	4-10	11-21	22-33	34-47	>47	TOTAL %	MEAN SPEED (KNOTS)
N	.8	3.3	3.8	.4			8.4	11.9
NE	.8	4.2	8.4	.4			13.8	12.2
E	1.7	7.5	4.6				13.8	9.4
SE	1.3	4.2	2.1				7.5	8.1
S	4.2	17.6	.8				22.6	5.8
SW	.8	7.9	5.9				14.6	9.4
W	1.7	9.6	.8				12.1	7.1
NW	.8	.8	1.3				2.9	9.1
CALM	4.2						4.2	.0
TOTAL	16.3	55.2	27.6	.8			100.0	8.3

MAX WIND
SPEED: 23 KNOTS
DIRECTION: 010 DEG
DAY: 12
HOUR: 06

JUNE DATA SUMMARY 44002

AVERAGE LATITUDE 40.1N AVERAGE LONGITUDE 073.0W

MEANS AND EXTREMES	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	12.5	(12 12)	17.2	20.5	(30 21)	239	30
SEA TEMP (DEG C)	13.7	(01 08)	17.1	19.4	(28 21)	239	30
AIR-SEA TEMP (DEG C)	-04.4	(12 12)	00.2	01.8	(06 15)	239	30
PRESSURE (MBAR)	1006.0	(05 21)	1018.6	1032.0	(26 21)	239	30

WIND - % FREQUENCIES, MEANS AND EXTREMES

NO. OF OBS: 239

DIR	<4	4-10	11-21	22-33	34-47	>47	TOTAL %	MEAN SPEED (KNOTS)
N	.8	2.9	4.6				8.4	11.5
NE		2.1	3.3	.4			5.9	12.4
E	2.9	5.9	1.7				10.5	8.4
SE	.8	5.0	1.3				7.1	8.9
S	2.1	22.2	5.4				29.7	8.0
SW	1.3	8.8	7.1				17.2	9.3
W	.4	8.4	5.0				13.8	9.0
NW	.8	2.1	3.8				6.7	10.3
CALM	.8						.8	.0
TOTAL	10.0	57.3	32.2	.4			100.0	8.8

MAX WIND
SPEED: 22 KNOTS
DIRECTION: 060 DEG
DAY: 19
HOUR: 06

JUNE DATA SUMMARY 44003

AVERAGE LATITUDE 40.8N AVERAGE LONGITUDE 068.5W

MEANS AND EXTREMES	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	08.6	(02 18)	12.3	17.0	(11 18)	239	30
SEA TEMP (DEG C)	08.7	(03 09)	10.1	12.7	(27 03)	239	30
AIR-SEA TEMP (DEG C)	-01.1	(02 18)	02.2	05.8	(12 06)	239	30
PRESSURE (MBAR)	1002.0	(05 18)	1018.7	1032.5	(27 03)	239	30

WIND - % FREQUENCIES, MEANS AND EXTREMES

NO. OF OBS: 239

DIR	<4	4-10	11-21	22-33	34-47	>47	TOTAL %	MEAN SPEED (KNOTS)
N	1.7	5.9	5.4				13.0	8.9
NE	1.7	4.2	2.9				8.8	8.0
E	2.5	13.0	1.3				16.7	5.8
SE	.8	12.1					13.0	5.3
S	1.7	7.1					8.8	6.9
SW	.8	10.9	4.6				16.3	8.3
W	.4	10.5	4.6				15.5	7.9
NW	2.1	2.9	.8				5.9	5.9
CALM	2.1						2.1	.0
TOTAL	13.0	66.5	18.7				100.0	7.0

MAX WIND
SPEED: 17 KNOTS
DIRECTION: 030 DEG
DAY: 18
HOUR: 21

WAVES - % FREQUENCIES, MEAN AND EXTREME (METERS) NO. OF WAVE OBS: 237

HEIGHT (M)	<1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	MEAN	MAX	(DA HR)
% FREQUENCY	21.1	72.6	6.3						1.1M	2.0M	(28 00)

JUNE DATA SUMMARY 44004

AVERAGE LATITUDE 38.0N AVERAGE LONGITUDE 070.0W

MEANS AND EXTREMES	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	15.8	(02 15)	20.2	23.4	(11 21)	147	18
SEA TEMP (DEG C)	18.8	(01 18)	21.4	22.7	(06 21)	147	18
AIR-SEA TEMP (DEG C)	-06.2	(12 21)	-01.2	01.2	(18 00)	147	18
PRESSURE (MBAR)	1003.7	(05 09)	1018.0	1028.9	(15 12)	147	18

WAVES - % FREQUENCIES, MEAN AND EXTREME (METERS) NO. OF WAVE OBS: 147

HEIGHT (M)	<1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	MEAN	MAX	(DA HR)
% FREQUENCY	39.8	58.8	1.4						.8M	3.0M	(13 00)

MAY — DATA SUMMARY — 44005

AVERAGE LATITUDE 42.7N — AVERAGE LONGITUDE 068.3W

MEANS AND EXTREMES

	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	04.7	(02 08)	09.0	16.9	(10 21)	234	31
SEA TEMP (DEG C)	06.5	(01 08)	09.0	12.5	(30 15)	234	31
AIR-SEA TEMP (DEG C)	-02.3	(02 08)	00.0	08.9	(10 21)	231	31
PRESSURE (MBAR)	1003.6	(08 08)	1017.5	1029.1	(18 15)	233	31

WIND - % FREQUENCIES, MEANS AND EXTREMES — NO. OF OBS: 234

DIR	<4	4-10	11-21	22-33	34-47	>47	TOTAL %	MEAN SPEED (KNOTS)
N		2.1	1.3				3.4	8.6
NE	.4	2.1	3.0				5.6	8.5
E	.4	5.6	7.3				13.2	10.4
SE	.4	8.1	3.4				12.0	8.1
S	.9	9.9	17.1				27.8	11.7
SW	.4	5.1	8.1				13.7	11.8
W	.9	6.8	9.4				17.1	11.0
NW		2.1	3.4				5.6	12.7
CALM	1.7						1.7	.0
TOTAL	5.1	41.9	53.0				100.0	10.7

MAX WIND — SPEED: 20 KNOTS — DIRECTION: 170 DEG — DAY: 25 — HOUR: 18

WAVES - % FREQUENCIES, MEAN AND EXTREME (METERS) — NO. OF WAVE OBS: 229

HEIGHT (M)	<1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	MEAN	MAX (DA HR)
% FREQUENCY	24.0	72.1	3.9						1.0M	2.5M (26 21)

MAY — DATA SUMMARY — 45001

AVERAGE LATITUDE 48.0N — AVERAGE LONGITUDE 087.8W

MEANS AND EXTREMES

	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	00.0	(06 03)	03.3	07.7	(17 21)	224	28
SEA TEMP (DEG C)	00.4	(11 15)	00.9	01.6	(30 21)	225	29
AIR-SEA TEMP (DEG C)	-00.4	(06 03)	02.4	06.7	(17 21)	224	28
PRESSURE (MBAR)	0998.7	(07 21)	1015.1	1028.4	(16 15)	225	28

WIND - % FREQUENCIES, MEANS AND EXTREMES — NO. OF OBS: 164

DIR	<4	4-10	11-21	22-33	34-47	>47	TOTAL %	MEAN SPEED (KNOTS)
N	1.8	10.4					12.2	5.6
NE	.6	2.4	.6				3.7	6.7
E	2.4	5.5	.6				8.5	7.0
SE		4.9	4.9				9.8	10.5
S	.6	9.8	13.4	1.8			25.6	12.9
SW		7.9	3.0				11.0	9.1
W	.6	8.1	9.5				18.3	10.4
NW	.6	6.7	.6				7.9	7.5
CALM	3.0						3.0	.0
TOTAL	9.8	56.7	31.7	1.8			100.0	9.4

MAX WIND — SPEED: 25 KNOTS — DIRECTION: 170 DEG — DAY: 07 — HOUR: 18

WAVES - % FREQUENCIES, MEAN AND EXTREME (METERS) — NO. OF WAVE OBS: 222

HEIGHT (M)	<1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	MEAN	MAX (DA HR)
% FREQUENCY	68.9	28.0	3.1						.8M	2.5M (18 06)

MAY — DATA SUMMARY — 46001

AVERAGE LATITUDE 56.0N — AVERAGE LONGITUDE 148.0W

MEANS AND EXTREMES

	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	03.2	(07 15)	05.6	07.8	(31 18)	246	31
SEA TEMP (DEG C)	05.3	(02 15)	06.2	07.7	(06 00)	247	31
AIR-SEA TEMP (DEG C)	-02.9	(07 15)	-00.6	00.9	(31 18)	246	31
PRESSURE (MBAR)	0983.5	(10 06)	1008.0	1021.3	(28 21)	247	31

WIND - % FREQUENCIES, MEANS AND EXTREMES — NO. OF OBS: 247

DIR	<4	4-10	11-21	22-33	34-47	>47	TOTAL %	MEAN SPEED (KNOTS)
N	1.2	2.0		.4	1.2		4.9	14.0
NE		.8	1.2	.8			2.8	14.3
E	.4	5.3	8.9	8.7	.4		24.3	18.5
SE	.4	6.9	13.4	1.6			22.3	12.8
S	.4	5.7	12.1				18.2	12.8
SW	.4	4.0	8.1	1.2			13.8	14.2
W		1.6	7.3	2.0			10.9	16.0
NW		1.2	.4	1.2			2.8	15.9
CALM								
TOTAL	2.8	27.5	51.0	17.0	1.6		100.0	15.0

MAX WIND — SPEED: 37 KNOTS — DIRECTION: 360 DEG — DAY: 10 — HOUR: 03

WAVES - % FREQUENCIES, MEAN AND EXTREME (METERS) — NO. OF WAVE OBS: 247

HEIGHT (M)	<1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	MEAN	MAX (DA HR)
% FREQUENCY		49.8	38.5	9.3	2.4				1.9M	4.9M (10 06)

MAY — DATA SUMMARY — 46002

AVERAGE LATITUDE 42.5N — AVERAGE LONGITUDE 130.0W

MEANS AND EXTREMES

	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	08.8	(05 18)	11.0	14.3	(26 00)	246	31
SEA TEMP (DEG C)	12.0	(08 15)	13.3	14.8	(26 00)	246	31
AIR-SEA TEMP (DEG C)	-03.3	(05 18)	-01.4	00.0	(03 18)	246	31
PRESSURE (MBAR)	1000.2	(05 03)	1021.6	1032.2	(26 21)	246	31

WIND - % FREQUENCIES, MEANS AND EXTREMES — NO. OF OBS: 246

DIR	<4	4-10	11-21	22-33	34-47	>47	TOTAL %	MEAN SPEED (KNOTS)
N		6.1	23.2	.4			28.7	14.0
NE	.4	1.2	3.7	.4			5.7	13.4
E	.8	.4	.4				1.6	6.8
SE		.8	2.0				2.8	14.1
S		2.8	4.5	1.2			8.5	14.0
SW	.4	2.8	6.1	.4			9.8	11.7
W	.8	9.8	4.5	2.0			17.1	11.7
NW		4.9	15.0	4.9			24.8	15.2
CALM								
TOTAL	2.4	28.8	58.3	9.3			100.0	13.5

MAX WIND — SPEED: 28 KNOTS — DIRECTION: 180 DEG — DAY: 04 — HOUR: 21

WAVES - % FREQUENCIES, MEAN AND EXTREME (METERS) — NO. OF WAVE OBS: 246

HEIGHT (M)	<1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	MEAN	MAX (DA HR)
% FREQUENCY		55.3	23.2	17.1	4.5				2.0M	4.5M (06 00)

MAY — DATA SUMMARY — 46003

AVERAGE LATITUDE 52.0N — AVERAGE LONGITUDE 156.0W

MEANS AND EXTREMES

	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	02.3	(01 21)	05.1	08.8	(28 09)	247	31
SEA TEMP (DEG C)	04.7	(03 18)	05.5	06.6	(08 00)	247	31
AIR-SEA TEMP (DEG C)	-02.7	(13 18)	-00.4	01.3	(16 00)	247	31
PRESSURE (MBAR)	0983.1	(03 03)	1004.0	1023.4	(18 09)	247	31

WIND - % FREQUENCIES, MEANS AND EXTREMES — NO. OF OBS: 247

DIR	<4	4-10	11-21	22-33	34-47	>47	TOTAL %	MEAN SPEED (KNOTS)
N		1.6	2.4	1.6			5.7	15.3
NE	.4	.8	.4	.8			2.4	15.2
E		.4	2.0	1.6			4.0	18.8
SE		1.6	10.1	2.4			14.2	14.7
S	.4	2.8	24.7	3.2			31.2	14.8
SW	.4	4.0	10.9	4.5			19.8	15.0
W	.8	3.6	10.9				15.4	12.1
NW		2.8	4.5				7.3	11.8
CALM								
TOTAL	2.0	17.8	66.0	14.2			100.0	14.5

MAX WIND — SPEED: 31 KNOTS — DIRECTION: 080 DEG — DAY: 13 — HOUR: 18

JUNE — DATA SUMMARY — 44005

AVERAGE LATITUDE 42.7N — AVERAGE LONGITUDE 068.3W

MEANS AND EXTREMES

	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	10.0	(01 15)	13.0	16.9	(16 03)	215	28
SEA TEMP (DEG C)	11.6	(06 12)	13.6	16.9	(29 21)	215	28
AIR-SEA TEMP (DEG C)	-02.1	(25 15)	00.3	03.3	(18 03)	215	28
PRESSURE (MBAR)	1003.0	(05 21)	1018.0	1031.6	(27 03)	215	28

WIND - % FREQUENCIES, MEANS AND EXTREMES — NO. OF OBS: 215

DIR	<4	4-10	11-21	22-33	34-47	>47	TOTAL %	MEAN SPEED (KNOTS)
N	.5	8.8	4.7				14.0	10.3
NE		1.9	3.7	.5			6.0	13.0
E	.5	4.2	.5				5.1	7.4
SE		4.2	.5				4.7	6.8
S	.9	16.3	15.3				32.6	10.2
SW		4.7	14.4				19.1	13.0
W		3.7	5.6	1.4			10.7	14.6
NW		6.5	.5	.5			7.4	7.8
CALM	.5						.5	.0
TOTAL	2.3	50.2	45.1	2.3			100.0	11.0

MAX WIND — SPEED: 24 KNOTS — DIRECTION: 300 DEG — DAY: 13 — HOUR: 12

WAVES - % FREQUENCIES, MEAN AND EXTREME (METERS) — NO. OF WAVE OBS: 190

HEIGHT (M)	<1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	MEAN	MAX (DA HR)
% FREQUENCY	38.0	57.8	4.4						1.0M	2.9M (13 16)

JUNE — DATA SUMMARY — 45001

AVERAGE LATITUDE 48.0N — AVERAGE LONGITUDE 087.8W

MEANS AND EXTREMES

	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	02.8	(08 09)	[illegible]	12.0	(26 06)	230	30
SEA TEMP (DEG C)	01.4	(01 12)	02.1	02.9	(27 18)	230	30
AIR-SEA TEMP (DEG C)	-01.6	(08 09)	03.7	08.5	(26 06)	230	30
PRESSURE (MBAR)	0998.6	(21 09)	1014.4	1028.5	(24 15)	230	30

WIND - % FREQUENCIES, MEANS AND EXTREMES — NO. OF OBS: 230

DIR	<4	4-10	11-21	22-33	34-47	>47	TOTAL %	MEAN SPEED (KNOTS)
N	2.1	8.4	2.5				13.0	7.0
NE	.8	2.9	.8				4.6	6.6
E	1.3	.4					1.7	5.0
SE	.8	6.7	7.5				15.1	10.1
S	.8	11.3	6.7				18.8	8.8
SW	2.1	10.0	4.6				16.7	8.1
W	2.1	14.2	2.9				19.2	8.0
NW	.8	7.1	1.7				9.6	7.0
CALM	1.3						1.3	.0
TOTAL	12.1	60.7	27.2				100.0	7.8

MAX WIND — SPEED: 21 KNOTS — DIRECTION: 210 DEG — DAY: 26 — HOUR: 06

WAVES - % FREQUENCIES, MEAN AND EXTREME (METERS) — NO. OF WAVE OBS: 230

HEIGHT (M) <1 1-1.5 2-2.5 3-3.5 4-5.5 6-7.5 8-9.5 >9.5 — MEAN — MAX (DA HR)

% FREQUENCY [illegible]

JUNE — DATA SUMMARY — 46001

AVERAGE LATITUDE 56.0N — AVERAGE LONGITUDE 148.0W

MEANS AND EXTREMES

	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	06.0	(07 15)	08.5	10.4	(23 12)	237	30
SEA TEMP (DEG C)	06.9	(04 15)	08.7	10.5	(23 06)	237	30
AIR-SEA TEMP (DEG C)	-01.6	(19 15)	-00.2	01.3	(14 15)	237	30
PRESSURE (MBAR)	0991.1	(04 06)	1016.4	1027.2	(24 03)	237	30

WIND - % FREQUENCIES, MEANS AND EXTREMES — NO. OF OBS: 237

DIR	<4	4-10	11-21	22-33	34-47	>47	TOTAL %	MEAN SPEED (KNOTS)
N	1.3	3.4	1.3				5.9	7.7
NE			.8				1.7	10.3
E		.4	1.7	2.5			4.6	10.7
SE		.4	6.0	.8			8.0	10.5
S	.4	3.8	8.7	4.6			18.6	10.1
SW		5.1	11.0	1.3			17.3	14.0
W	.8	8.4	27.0	.8			37.1	13.3
NW		2.5	4.2				6.8	11.5
CALM								
TOTAL	2.5	24.9	62.4	10.1			100.0	14.0

MAX WIND — SPEED: 28 KNOTS — DIRECTION: 100 DEG — DAY: 03 — HOUR: 12

WAVES - % FREQUENCIES, MEAN AND EXTREME (METERS) — NO. OF WAVE OBS: 237

HEIGHT (M)	<1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	MEAN	MAX (DA HR)
% FREQUENCY	5.9	63.3	28.1	1.7					1.5M	3.0M (03 12)

JUNE — DATA SUMMARY — 46002

AVERAGE LATITUDE 42.5N — AVERAGE LONGITUDE 130.0W

MEANS AND EXTREMES

	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	11.7	(18 15)	13.4	17.0	(28 03)	237	30
SEA TEMP (DEG C)	13.9	(01 15)	14.8	17.6	(28 00)	237	30
AIR-SEA TEMP (DEG C)	-02.8	(24 15)	-01.5	01.0	(28 03)	237	30
PRESSURE (MBAR)	1010.6	(05 03)	1024.7	1031.4	(07 21)	237	30

WIND - % FREQUENCIES, MEANS AND EXTREMES — NO. OF OBS: 237

DIR	<4	4-10	11-21	22-33	34-47	>47	TOTAL %	MEAN SPEED (KNOTS)
N	1.3	11.8	38.2	.8			53.2	13.1
NE		1.3	.4				1.7	7.8
E	.4						.4	3.1
SE		.4	.4				.8	8.5
S		1.7	.4				2.1	8.4
SW	.4	2.1	2.1				4.6	9.3
W	.4	3.0	7.6				11.0	12.2
NW	.4	5.9	19.0	.4			25.7	13.5
CALM	.4						.4	.0
TOTAL	3.4	26.2	68.2	1.3			100.0	12.8

MAX WIND — SPEED: 24 KNOTS — DIRECTION: 320 DEG — DAY: 18 — HOUR: 18

WAVES - % FREQUENCIES, MEAN AND EXTREME (METERS) — NO. OF WAVE OBS: 237

HEIGHT (M)	<1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	MEAN	MAX (DA HR)
% FREQUENCY		77.2	22.8						1.4M	2.5M (17 15)

JUNE — DATA SUMMARY — 46003

AVERAGE LATITUDE 52.0N — AVERAGE LONGITUDE 156.0W

MEANS AND EXTREMES

	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	05.8	(14 12)	07.5	10.8	(30 21)	237	30
SEA TEMP (DEG C)	06.1	(02 15)	07.6	10.3	(22 03)	237	30
AIR-SEA TEMP (DEG C)	-01.8	(14 12)	-00.1	01.8	(30 21)	237	30
PRESSURE (MBAR)	0988.5	(03 03)	1018.0	1037.1	(11 21)	237	30

WIND - % FREQUENCIES, MEANS AND EXTREMES — NO. OF OBS: 237

DIR	<4	4-10	11-21	22-33	34-47	>47	TOTAL %	MEAN SPEED (KNOTS)
N		2.5					2.5	8.0
NE		.4					.4	4.0
E								
SE	.4	3.0	3.0				6.3	9.8
S		1.7	5.9				7.6	12.0
SW		1.7	11.8	2.1			15.6	18.3
W	.4	5.5	37.1	3.0			46.0	14.8
NW		2.5	18.6	.4			21.5	13.7
CALM								
TOTAL	.8	17.3	76.4	5.5			100.0	14.1

MAX WIND — SPEED: 28 KNOTS — DIRECTION: 260 DEG — DAY: 01 — HOUR: 18

MAY — DATA SUMMARY — 46004

AVERAGE LATITUDE 51.0N — AVERAGE LONGITUDE 136.0W

MEANS AND EXTREMES	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	05.8	(08 18)	07.8	10.3	(31 03)	247	31
SEA TEMP (DEG C)	07.2	(12 12)	08.0	09.5	(28 03)	247	31
AIR-SEA TEMP (DEG C)	-01.7	(20 12)	-00.1	01.4	(25 08)	247	31
PRESSURE (MBAR)	0996.7	(05 18)	1016.7	1033.1	(19 00)	247	31

WIND - % FREQUENCIES, MEANS AND EXTREMES — NO. OF OBS: 247

DIR	<4	4-10	11-21	22-33	34-47	>47	TOTAL %	MEAN SPEED (KNOTS)
N		.8	1.6	2.8			5.3	20.0
NE			.4				.4	17.0
E		.4	.8	2.0			3.2	21.4
SE		4.9	7.3	1.6			13.8	14.1
S		8.1	18.6	3.6	1.2		31.6	15.5
SW		4.9	10.9	.8	.4		17.0	13.5
W	.8	4.9	13.0	1.2	.4		20.2	14.0
NW	.4	.4	5.7	2.0			8.5	17.4
CALM								
TOTAL	1.2	24.3	58.3	14.2	2.0		100.0	15.3

MAX WIND — SPEED: 38 KNOTS; DIRECTION: 230 DEG; DAY: 10; HOUR: 06

WAVES - % FREQUENCIES, MEAN AND EXTREME (METERS) — NO. OF WAVE OBS: 247

HEIGHT (M)	<1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	MEAN	MAX (DA HR)
% FREQUENCY		46.2	41.3	8.9	2.0	1.6			2.0M	6.5M (10 21)

MAY — DATA SUMMARY — 46005

AVERAGE LATITUDE 46.0N — AVERAGE LONGITUDE 131.0W

MEANS AND EXTREMES	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	08.2	(07 18)	10.4	14.7	(30 21)	247	31
SEA TEMP (DEG C)	09.5	(08 15)	11.1	16.3	(31 00)	247	31
AIR-SEA TEMP (DEG C)	-02.3	(31 00)	-00.6	01.0	(26 00)	247	31
PRESSURE (MBAR)	0993.9	(05 06)	1020.0	1034.2	(18 21)	247	31

WIND - % FREQUENCIES, MEANS AND EXTREMES — NO. OF OBS: 247

DIR	<4	4-10	11-21	22-33	34-47	>47	TOTAL %	MEAN SPEED (KNOTS)
N	1.6	3.2	2.0	.8			7.7	9.2
NE	1.2	1.6	2.0				4.9	7.9
E	.4	.4	1.2				2.0	11.0
SE	.4	1.2	3.2	.8			5.7	13.9
S	.4	2.4	14.2	1.2			18.2	15.4
SW	1.2	5.7	7.3	.4			14.6	10.7
W	1.2	9.7	11.7	7.3			30.0	14.9
NW	.8	4.9	8.1	2.4	.8		17.0	15.0
CALM								
TOTAL	7.3	28.1	49.8	13.0	.8		100.0	13.5

MAX WIND — SPEED: 34 KNOTS; DIRECTION: 310 DEG; DAY: 08; HOUR: 03

WAVES - % FREQUENCIES, MEAN AND EXTREME (METERS) — NO. OF WAVE OBS: 247

HEIGHT (M)	<1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	MEAN	MAX (DA HR)
% FREQUENCY	1.6	53.0	32.0	9.7	3.6				1.8M	4.5M (07 21)

MAY — DATA SUMMARY — 46006

AVERAGE LATITUDE 41.0N — AVERAGE LONGITUDE 138.0W

MEANS AND EXTREMES	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	08.5	(07 15)	12.5	15.2	(25 06)	248	31
SEA TEMP (DEG C)	11.3	(07 15)	12.9	15.2	(28 03)	248	31
AIR-SEA TEMP (DEG C)	-02.9	(07 15)	-00.4	01.2	(11 21)	248	31
PRESSURE (MBAR)	1000.7	(04 15)	1023.4	1034.2	(18 18)	248	31

WIND - % FREQUENCIES, MEANS AND EXTREMES — NO. OF OBS: 248

DIR	<4	4-10	11-21	22-33	34-47	>47	TOTAL %	MEAN SPEED (KNOTS)
N		2.0	.8				2.8	8.6
NE		1.6					1.6	8.0
E		2.4	1.2				3.6	9.7
SE		4.4	2.8				7.3	10.4
S	1.2	6.9	22.6	2.0			32.7	13.0
SW	.4	3.2	9.3	.8			13.7	13.5
W	.4	5.2	9.7	5.2			20.6	14.8
NW	.8	4.4	12.1				17.3	13.0
CALM	.4						.4	.0
TOTAL	3.2	30.2	58.5	8.1			100.0	12.9

MAX WIND — SPEED: 31 KNOTS; DIRECTION: 200 DEG; DAY: 05; HOUR: 12

WAVES - % FREQUENCIES, MEAN AND EXTREME (METERS) — NO. OF WAVE OBS: 248

HEIGHT (M)	<1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	MEAN	MAX (DA HR)
% FREQUENCY	1.2	55.6	29.8	10.5	2.8				1.8M	4.5M (05 15)

MAY — DATA SUMMARY — 46007

AVERAGE LATITUDE 59.2N — AVERAGE LONGITUDE 152.7W

MEANS AND EXTREMES	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	02.6	(02 12)	05.5	10.4	(28 03)	227	31
SEA TEMP (DEG C)	03.7	(08 15)	05.1	06.5	(26 06)	226	31
AIR-SEA TEMP (DEG C)	-02.2	(02 15)	00.4	04.5	(28 03)	223	31
PRESSURE (MBAR)	0994.2	(17 03)	1009.9	1023.7	(31 00)	228	31

WIND - % FREQUENCIES, MEANS AND EXTREMES — NO. OF OBS: 225

DIR	<4	4-10	11-21	22-33	34-47	>47	TOTAL %	MEAN SPEED (KNOTS)
N	2.2	4.0	.9				7.1	6.5
NE	1.3	5.8	.9				8.0	6.4
E	.4	11.6	28.4	1.3			41.8	13.2
SE		7.1	10.7				17.8	12.3
S	.4	2.7					3.1	6.6
SW		3.1	.4				3.6	7.5
W	1.8	4.9	8.9	.4			16.0	11.4
NW		1.8	.4	.4			2.7	11.3
CALM								
TOTAL	6.2	40.9	50.7	2.2			100.0	11.3

MAX WIND — SPEED: 25 KNOTS; DIRECTION: 100 DEG; DAY: 16; HOUR: 06

MAY — DATA SUMMARY — 46009

AVERAGE LATITUDE 60.2N — AVERAGE LONGITUDE 146.8W

MEANS AND EXTREMES	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	02.9	(09 21)	06.3	09.6	(31 15)	247	31
SEA TEMP (DEG C)	04.5	(02 12)	06.5	09.4	(31 12)	247	31
AIR-SEA TEMP (DEG C)	-03.1	(09 21)	-00.2	02.7	(04 09)	247	31
PRESSURE (MBAR)	0997.6	(07 15)	1012.7	1027.5	(30 21)	247	31

WIND - % FREQUENCIES, MEANS AND EXTREMES — NO. OF OBS: 246

DIR	<4	4-10	11-21	22-33	34-47	>47	TOTAL %	MEAN SPEED (KNOTS)
N	2.4	5.7	2.0				10.2	7.2
NE	.4	5.3	.4				6.1	5.7
E	1.2	6.1	17.9	2.0			27.2	14.2
SE	.8	10.2	20.3	1.2			32.5	12.8
S	1.2	10.2	2.0				13.4	6.6
SW	2.0	3.7	.4				6.1	5.0
W	1.2	.8					2.0	3.2
NW	.4	.8					1.2	4.0
CALM	1.2						1.2	.0
TOTAL	11.0	42.7	43.1	3.3			100.0	10.4

MAX WIND — SPEED: 28 KNOTS; DIRECTION: 110 DEG; DAY: 04; HOUR: 18

JUNE — DATA SUMMARY — 46004

AVERAGE LATITUDE 51.0N — AVERAGE LONGITUDE 136.0W

MEANS AND EXTREMES	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	08.0	(05 09)	09.8	12.5	(20 00)	238	30
SEA TEMP (DEG C)	09.2	(11 15)	10.3	14.4	(27 00)	238	30
AIR-SEA TEMP (DEG C)	-02.8	(30 18)	-00.5	01.0	(01 06)	238	30
PRESSURE (MBAR)	1002.0	(04 21)	1021.8	1033.9	(07 15)	238	30

WIND - % FREQUENCIES, MEANS AND EXTREMES — NO. OF OBS: 238

DIR	<4	4-10	11-21	22-33	34-47	>47	TOTAL %	MEAN SPEED (KNOTS)
N		3.8	4.6				8.4	11.1
NE	.4	.8	2.1				3.3	11.3
E			1.7				1.7	13.3
SE		1.3	1.3				2.5	11.3
S		2.1	8.4	2.9			13.4	16.6
SW	.8	2.9	14.2	.4			18.4	13.3
W		5.4	26.8	2.1			34.3	14.6
NW		2.1	15.1	.4			17.6	14.6
CALM	.4						.4	.0
TOTAL	1.7	18.4	74.1	5.9			100.0	14.0

MAX WIND — SPEED: 28 KNOTS; DIRECTION: 270 DEG; DAY: 05; HOUR: 03

WAVES - % FREQUENCIES, MEAN AND EXTREME (METERS) — NO. OF WAVE OBS: 238

HEIGHT (M)	<1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	MEAN	MAX (DA HR)
% FREQUENCY	9.6	66.1	22.6	1.7					1.4M	3.0M (01 15)

JUNE — DATA SUMMARY — 46005

AVERAGE LATITUDE 46.0N — AVERAGE LONGITUDE 131.0W

MEANS AND EXTREMES	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	09.3	(01 12)	12.1	15.7	(27 03)	238	30
SEA TEMP (DEG C)	12.0	(06 15)	13.1	16.8	(27 03)	238	30
AIR-SEA TEMP (DEG C)	-03.5	(01 12)	-01.0	01.1	(01 21)	238	30
PRESSURE (MBAR)	1011.2	(05 03)	1023.7	1033.1	(07 18)	238	30

WIND - % FREQUENCIES, MEANS AND EXTREMES — NO. OF OBS: 238

DIR	<4	4-10	11-21	22-33	34-47	>47	TOTAL %	MEAN SPEED (KNOTS)
N	2.1	7.5	9.6	.8			20.1	11.3
NE		2.9					2.9	4.7
E		1.3					1.3	7.3
SE	1.7	2.5					4.2	4.8
S	.4	.4	1.3	.8			2.9	15.3
SW	.4	2.5	7.9	.4			11.3	13.2
W	1.7	10.0	13.8	.4			25.9	11.6
NW	2.1	7.9	18.4	2.9			31.4	13.4
CALM								
TOTAL	8.4	35.1	51.0	5.4			100.0	11.8

MAX WIND — SPEED: 25 KNOTS; DIRECTION: 330 DEG; DAY: 30; HOUR: 12

WAVES - % FREQUENCIES, MEAN AND EXTREME (METERS) — NO. OF WAVE OBS: 238

HEIGHT (M)	<1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	MEAN	MAX (DA HR)
% FREQUENCY	11.7	73.2	15.1						1.3M	2.5M (17 00)

JUNE — DATA SUMMARY — 46006

AVERAGE LATITUDE 41.0N — AVERAGE LONGITUDE 138.0W

MEANS AND EXTREMES	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	11.7	(18 15)	14.3	17.0	(09 18)	227	30
SEA TEMP (DEG C)	14.8	(01 15)	15.6	17.0	(10 03)	227	30
AIR-SEA TEMP (DEG C)	-03.8	(10 15)	-01.4	01.5	(09 18)	227	30
PRESSURE (MBAR)	1017.1	(28 03)	1028.0	1035.6	(07 09)	227	30

WIND - % FREQUENCIES, MEANS AND EXTREMES — NO. OF OBS: 227

DIR	<4	4-10	11-21	22-33	34-47	>47	TOTAL %	MEAN SPEED (KNOTS)
N	.9	4.8	12.3				18.1	11.9
NE	.9	4.0	4.0				8.8	9.8
E	.4	4.4	1.3				6.2	8.0
SE	.4						.4	2.0
S	.4	6.2	4.4	1.8			12.8	12.1
SW	.9	5.7	3.5	.4			10.6	9.5
W	1.3	5.7	4.4				11.5	9.3
NW	2.2	3.5	24.2	.4			30.4	12.9
CALM	1.3						1.3	.0
TOTAL	8.8	34.4	54.2	2.6			100.0	11.1

MAX WIND — SPEED: 26 KNOTS; DIRECTION: 170 DEG; DAY: 28; HOUR: 03

WAVES - % FREQUENCIES, MEAN AND EXTREME (METERS) — NO. OF WAVE OBS: 227

HEIGHT (M)	<1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	MEAN	MAX (DA HR)
% FREQUENCY	1.3	87.2	11.5						1.3M	2.5M (28 06)

JUNE — DATA SUMMARY — 46007

AVERAGE LATITUDE 59.2N — AVERAGE LONGITUDE 152.7W

MEANS AND EXTREMES	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	06.0	(05 15)	07.8	10.8	(10 03)	96	16
SEA TEMP (DEG C)	05.0	(01 18)	06.3	08.8	(11 00)	93	16
AIR-SEA TEMP (DEG C)	-00.4	(02 21)	01.4	04.3	(10 03)	93	16
PRESSURE (MBAR)	0993.8	(04 12)	1013.3	1025.6	(10 21)	96	16

WIND - % FREQUENCIES, MEANS AND EXTREMES — NO. OF OBS: 93

DIR	<4	4-10	11-21	22-33	34-47	>47	TOTAL %	MEAN SPEED (KNOTS)
N	2.2						2.2	2.5
NE		2.2	2.2				4.3	9.8
E	2.2	5.4	23.7				31.2	12.2
SE		4.3	9.7				14.0	13.0
S		8.6					8.6	6.7
SW		3.2	1.1				4.3	9.0
W	2.2	4.3	23.7	3.2			33.3	15.2
NW	1.1	1.1					2.2	3.5
CALM								
TOTAL	7.5	29.0	60.2	3.2			100.0	12.2

MAX WIND — SPEED: 23 KNOTS; DIRECTION: 280 DEG; DAY: 13; HOUR: 12

JUNE — DATA SUMMARY — 46009

AVERAGE LATITUDE 60.2N — AVERAGE LONGITUDE 146.8W

MEANS AND EXTREMES	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	07.1	(02 12)	09.4	12.8	(13 03)	238	30
SEA TEMP (DEG C)	07.6	(05 12)	09.6	11.8	(30 06)	238	30
AIR-SEA TEMP (DEG C)	-03.5	(19 06)	-00.2	04.5	(15 06)	238	30
PRESSURE (MBAR)	0999.3	(04 15)	1016.5	1026.3	(07 21)	238	30

WIND - % FREQUENCIES, MEANS AND EXTREMES — NO. OF OBS: 239

DIR	<4	4-10	11-21	22-33	34-47	>47	TOTAL %	MEAN SPEED (KNOTS)
N	2.5	2.9	2.1				7.5	7.5
NE	1.7	4.2	.4				6.3	5.0
E	1.7	4.6	10.0	2.5			18.8	13.7
SE	.4	13.0	11.3				24.7	10.8
S	3.3	15.5	2.9				21.8	6.8
SW	2.9	8.8	.4				12.1	5.6
W	.8	2.5					3.3	4.9
NW	1.3	.8					2.1	3.6
CALM	3.3						3.3	.0
TOTAL	18.0	52.3	27.2	2.5			100.0	8.5

MAX WIND — SPEED: 25 KNOTS; DIRECTION: 110 DEG; DAY: 17; HOUR: 06

Table 9

Selected Gale and Wave Observations, North Atlantic

May and June 1979

Vessel	Nationality	Date	Position of Ship Lat. deg.	Position of Ship Long. deg.	Time GMT	Wind Dir. 10°	Wind Speed kt.	Visibility n. mi.	Present Weather code	Pressure mb.	Temperature °C Air	Temperature °C Sea	Sea Waves+ Period sec.	Sea Waves+ Height ft.	Swell Waves Dir. 10°	Swell Waves Period sec.	Swell Waves Height ft.
NORTH ATLANTIC OCEAN		MAY															
YOUNG AMERICA	AMERICAN	1	49.7 N	11.2 W	18	31	40	10 NM	25	1013.0	9.4	9.4	3	6.5	31	11	16.5
YOUNG AMERICA	AMERICAN	2	49.6 N	14.0 W	00	31	40	10 NM	01	1018.0	9.5	10.0	3	6.5	31	>13	16.5
SEALAND MARKET	AMERICAN	5	36.9 N	58.2 W	18	25	35	5 NM	02	1007.1	20.0	16.6	5	16.5	25	7	14.5
YOUNG AMERICA	AMERICAN	6	40.0 N	62.4 W	00	32	40	10 NM	01	1000.5	12.7	16.7	4	8	31	6	10
SEALAND MARKET	AMERICAN	6	36.9 N	61.2 W	00	28	35	5 NM	18	1009.1	21.1	19.5	5	16.5	26	9	19.5
AMER ALLIANCE	AMERICAN	6	43.7 N	46.5 W	12	27	30	10 NM	02	1000.4	10.0	8.0			27	6	24.5
ROBERT E LEE	AMERICAN	7	40.2 N	32.2 W	06	23	M 36	5 NM	02	1015.2	17.3	16.2	3	5			
GOLDEN DOLPHIN	AMERICAN	7	49.0 N	64.0 W	03	30	40	5 NM	01	1001.7	5.1	2.3	3	5	30	6	19.5
AMER LEGEND	AMERICAN	7	44.2 N	43.5 W	00	26	35	5 NM	02	1008.5	10.6	10.6	8	18			
GREAT REPUBLIC	AMERICAN	8	40.8 N	54.9 W	12	31	35	10 NM	02	1008.2	9.5	11.1	5	11.5	32	7	14.5
SEALAND VENTURE	AMERICAN	8	39.4 N	54.8 W	18	30	35	10 NM	03	1010.5	12.3	18.3	8	13			
AMER LEGEND	AMERICAN	8	42.5 N	53.0 W	06	27	35	5 NM	02	999.8	4.4	3.3	8	16.5			
ROBERT E LEE	AMERICAN	9	40.0 N	52.8 W	18	30	M 44	10 NM	02	1007.0	8.2	15.5	3	13	29	12	16.5
SEALAND VENTURE	AMERICAN	9	40.0 N	49.9 W	06	31	47	10 NM	02	999.7	9.4	18.9	8	13	31	11	24.5
GUAYAMA	AMERICAN	11	38.0 N	49.0 W	18	23	40	5 NM	07	1003.0	16.7	18.3	6	10	27	6	13
DYVI KATTEGAT	NORWEGIAN	11	42.3 N	53.2 W	12	31	35	10 NM	03	1001.0	5.3						
ADM W M CALLAGHAN	AMERICAN	11	40.7 N	58.7 W	18	33	40	10 NM	03	1012.9	9.5	16.8	5	10			
GUAYAMA	AMERICAN	12	38.4 N	52.6 W	06	31	40	5 NM	02	1014.0	16.1	17.2					
COMET	AMERICAN	14	56.9 N	20.1 W	06	24	28	10 NM	18	1010.8	12.2	7.8	3	10	23	9	24.5
EXXON NEWARK	AMERICAN	17	34.4 N	74.9 W	06	03	35	10 NM	18	1020.8	22.5	28.9	5	10			
EXXON WASHINGTON	AMERICAN	17	31.6 N	78.2 W	18	04	35	5 NM	03	1021.0	23.7	23.3	8	16.5			
AMER ALLIANCE	AMERICAN	17	49.6 N	07.3 W	06	25	40	10 NM	15	999.9	10.0	10.5	6	13	27	9	19.5
TILLIE LYKES	AMERICAN	18	46.1 N	16.7 W	12	36	38	10 NM	02	1018.0	11.1	12.7	7	16.5	02	10	16.5
YOUNG AMERICA	AMERICAN	19	49.6 N	13.4 W	18	20	36	5 NM	02	1012.0	12.7	11.7	3	8	21	6	11.5
GREAT REPUBLIC	AMERICAN	20	48.2 N	28.8 W	18	31	35	10 NM	02	1013.0	11.2	8.8	6	10	31	8	14.5
MORMACTIDE	AMERICAN	21	34.2 N	55.4 W	18	14	35	2 NM	25	1016.0	20.0	20.0	5	13	14	7	11.5
EXXON BOSTON	AMERICAN	23	35.8 N	73.5 W	12	20	40	5 NM	58	1015.2	23.7	26.7	6	24.5			
DELAWARE GETTY	AMERICAN	25	34.5 N	75.0 W	06	19	37	5 NM	02	1006.0	23.2	17.0	5	5	19	10	8
SAN MARCOS	AMERICAN	25	34.2 N	76.5 W	00	18	35	5 NM	25	1007.0	25.0	23.8	6	3	16	6	8
EXXON BOSTON	AMERICAN	26	35.0 N	74.1 W	00	23	35	10 NM	01	1005.0	24.5	26.5	5	21			
AMER ACE	AMERICAN	26	42.9 N	45.1 W	06	27	36	5 NM	02	1023.4	17.8	18.3	3	10			
SEALAND MARKET	AMERICAN	26	36.8 N	65.0 W	12	18	45	5 NM	18	1013.5	25.6	22.2	5	6.5	26	8	11.5
DYVI KATTEGAT	NORWEGIAN	27	45.6 N	28.2 W	06	30	36	5 NM	81	1005.0	11.0						
YOUNG AMERICA	AMERICAN	27	49.2 N	20.3 W	18	29	40	5 NM	81	990.5	13.9	11.2	4	8	27	8	18
DYVI KATTEGAT	NORWEGIAN	28	44.4 N	34.9 W	00	30	35	5 NM	80	1013.0	12.0						
AMER CORSAIR	AMERICAN	31	38.8 N	28.3 W	12	23	35	10 NM	58	1016.0	16.7	17.8	3	8	26	< 6	11.5
GREAT LAKES VESSELS																	
A H FERBERT	AMERICAN	7	47.7 N	87.9 W	12	15	M 36	1 NM	05		5.0	2.0	3	8			
HERBERT C JACKSON	AMERICAN	17	43.6 N	87.1 W	18	17	M 38	10 NM	02		10.0	3.0	4	6.5			
CLIFFS VICTORY	AMERICAN	18	46.8 N	86.2 W	00	19	M 38	> 25 NM	03		14.0	2.0	3	8			
RALPH H WATSON	AMERICAN	18	47.2 N	87.3 W	00	15	M 35	10 NM	02		9.0	2.0	8	8			
ARMCO	AMERICAN	25	42.0 N	81.5 W	06	02	M 36	2 NM	63		7.0	10.0	6	6.5			
HENRY FORD II	AMERICAN	25	41.7 N	82.8 W	00	02	M 38	2 NM	62		8.0	8.0	4	6.5			
HERBERT C JACKSON	AMERICAN	25	44.0 N	86.6 W	18	35	M 42	> 25 NM	00		11.0	3.0	3	8			
GEORGE A SLOAN	AMERICAN	25	42.0 N	82.7 W	12	02	M 40	2 NM	21		10.0	15.0	6	5			
GEORGE A SLOAN	AMERICAN	26	42.0 N	82.7 W	00	35	M 40	2 NM	21		8.0	12.0	6	5			
ENVIRONMENTAL BUOYS																	
42002	AMERICAN	4	26.0N	93.5W	21	02	M 35			1011.8	21.4	24.0					
NORTH ATLANTIC OCEAN		JUNE															
BARMA	NORWEGIAN	1	52.9 N	19.1 W	18	13	M 35	5 NM	03	1011.0	12.0	11.0	6	8	14	9	16.5
MAUMEE	AMERICAN	1	43.2 N	32.5 W	12	30	35	10 NM	01	997.0	11.7	13.4	2	6.5	30	< 6	8
AMER CORSAIR	AMERICAN	1	39.4 N	34.1 W	06	28	40	10 NM	02	1006.5	16.1	18.9	9	18			
BARMA	NORWEGIAN	2	53.6 N	17.5 W	00	13	M 35	5 NM	60	1016.5	11.5	11.5	6	8	14	9	16.5
AMER ARGOSY	AMERICAN	2	46.7 N	23.7 W	00	15	40	10 NM	01	997.6	11.7	13.3	6	11.5			
HELLESPONT GLORY	SINGAPORE	3	42.0 N	45.4 W	11	06	M 50	5 NM	21	1006.0	15.0	17.0	10	19.5			
AMER CORSAIR	AMERICAN	3	41.2 N	50.0 W	06	07	35	5 NM	50	1005.5	15.0	18.3	5	10	04	11	11.5
SEALAND MARKET	AMERICAN	3	40.6 N	52.7 W	00	03	35	10 NM	15	1001.7	15.7	21.2	8	14.5	01	12	14.5
DELAWARE GETTY	AMERICAN	12	25.0 N	68.9 W	06	11	35	10 NM	01	1011.2	23.3	27.8	3	5	11	7	6.5
MORMACVEGA	AMERICAN	14	28.9 N	79.5 W	00	05	38	5 NM	62	1014.8	26.7	28.4	3	6.5			
GRAND FELICITY	PANAMANIAN	15	44.8 N	53.0 W	18	29	M 38	10 NM	01	1018.0	17.0						
EXPORT BANNER	AMERICAN	15	32.2 N	66.1 W	12	05	35	10 NM	03	1020.7	22.5	24.5	3	10			
TAMPA	AMERICAN	21	20.1 N	82.1 W	06	12	35	5 NM	13	1017.3	25.5	30.5	4	6.5	12	6	6.5
CARBIDE SEADRIFT	AMERICAN	21	36.0 N	72.8 W	00	02	35	10 NM	01	1023.0	21.1	25.6	3	5	02	9	13
GULFFARMER	AMERICAN	22	13.9 N	77.3 W	12	08	35	5 NM	07	1011.2	28.3	26.2	5	6.5	09	8	11.5
SEALAND GALLOWAY	AMERICAN	24	39.8 N	63.2 W	12	24	35	5 NM	81	1016.9	19.5	20.0	4	8			
TAMPA	AMERICAN	24	17.5 N	72.6 W	00	12	35	10 NM	02	1014.0	29.4	29.4	2	6.5	12	6	8
UNION PROGRESS	LIBERIAN	26	49.5 N	29.0 W	18	25	M 36	< 50 YD	11	1018.5	18.3	15.0					
ROBERTS BANK	LIBERIAN	26	20.5 N	18.1 W	00	02	35	5 NM	02	1017.0	20.0	20.0	6	8	36	9	11.5
EXPORT LEADER	AMERICAN	26	39.9 N	55.4 W	18	29	35	2 NM	51	1018.0	18.9	21.2	6	6.5			
UNION PROGRESS	LIBERIAN	27	49.1 N	31.1 W	00	25	M 38	< 50 YD	11	1019.5	17.0	14.0					
GREAT LAKES VESSELS																	
T W ROBINSON	AMERICAN	11	44.4 N	83.2 W	06	34	M 37	5 NM	21		10.0	11.0		5			
ERNEST R BREECH	AMERICAN	17	47.1 N	86.2 W	12	36	M 38	10 NM	02		8.0	4.0		6.5			
CASON J CALLAWAY	AMERICAN	17	47.0 N	86.0 W	06	06	M 36	< 50 YD	45		6.0	4.0					
EUGENE W PARGNY	AMERICAN	18	44.2 N	82.7 W	00	33	M 35	> 25 NM	15		10.0	14.0	3	6.5			
HOMER D WILLIAMS	AMERICAN	20	47.6 N	87.5 W	18	16	M 36	5 NM	05		10.0	2.0	XX	8			
BENJAMIN F FAIRLESS	AMERICAN	27	47.6 N	88.1 W	00	28	M 38	5 NM	04		18.0	5.0	3	5			

\+ Direction for sea waves same as wind direction
X Direction or period of waves indeterminate
M Measured wind

NOTE: The observations are selected from those with winds ≥ 35 kn or waves ≥ 25 ft from May through August (≥ 41 kn or ≥ 33 ft, September through April). In cases where a ship reported more than one observation a day with such values, the one with the highest windspeed was selected.

Table 10
Selected Gale and Wave Observations, North Pacific
May and June 1979

Vessel	Nationality	Date	Position of Ship Lat. deg.	Position of Ship Long. deg.	Time GMT	Wind Dir. 10°	Wind Speed kt.	Visibility n. mi.	Present Weather code	Pressure mb.	Temperature °C. Air	Temperature °C. Sea	Sea Waves† Period sec.	Sea Waves† Height ft.	Swell Waves Dir. 10°	Swell Waves Period sec.	Swell Waves Height ft.
NORTH PACIFIC OCEAN		MAY															
JARVIS	AMERICAN	1	54.3 N	172.3 W	06	35	M 41	1 NM	68	995.1	1.7	3.4	9	10			
ALEUTIAN DEVELOPER	AMERICAN	1	56.5 N	155.5 W	12	09	M 43	5 NM	51	991.9	5.5	2.8	4	10	09	6	11.5
VANGUARD	LIBERIAN	1	43.0 N	151.5 E	06	25	M 42	5 NM	01	994.0	5.0	2.0			25	12	23
SEALAND PIONEER	AMERICAN	1	48.4 N	158.7 E	12	17	M 40	200 YD	45	986.8	2.0	2.0					
VIOLET	LIBERIAN	1	34.6 N	153.4 E	00	19	M 40	2 NM	18	1015.0	19.0	20.0	8	8			
ORIENTAL STATESMAN	LIBERIAN	1	37.5 N	161.0 E	06	20	M 38	2 NM	02	1016.0	15.0	13.0	6	13	18	8	16.5
HONSHU GLORIA	LIBERIAN	1	45.1 N	152.5 E	18	30	M 46	5 NM	03	996.0	2.0	2.0					
NORTH STAR III	AMERICAN	1	56.3 N	161.0 W	06	10	M 37	> 25 NM	02	988.8	5.8	4.4	5	10	05	6	10
PRES JEFFERSON	AMERICAN	1	39.9 N	146.8 E	00	27	35	5 NM	01	1002.5	7.8	2.2	4	11.5	25	7	14.5
PRES PIERCE	AMERICAN	1	27.9 N	126.1 E	00	05	40	5 NM	02	1009.8	22.5	22.7	5	5	05	8	8
PRES TAFT	AMERICAN	1	38.9 N	170.9 W	12	29	35	10 NM	03	1021.9	10.0	11.7					
CRESSIDA	PANAMANIAN	1	46.6 N	153.4 E	00	11	M 40	200 YD	69	988.0	3.0	0.7	8	23			
GLADIOLUS	LIBERIAN	1	45.0 N	149.2 E	06	28	M 42	2 NM	68	985.0	1.0	2.0	9	14.5			
BLUE OCEAN	JAPANESE	2	52.6 N	174.1 W	06	27	M 35	1 NM	05	1002.0	4.0	3.0	9	6.5			
CHEVRON WASHINGTON	AMERICAN	2	38.2 N	123.4 W	00	31	M 38	10 NM	02	1011.8	12.8		6	5			
KOFUKU MARU	JAPANESE	2	45.0 N	160.3 W	06	23	M 45	2 NM	27	1001.0	5.5	7.5	8	19.5			
JAPAN AMBASSADOR	JAPANESE	2	45.8 N	152.9 W	18	25	M 24	5 NM	21	1001.5	10.0	8.0	5	10	25	11	26
PRES JOHNSON	AMERICAN	2	48.8 N	170.6 W	00	34	35	2 NM	02	1005.0	3.9	2.8	4	13	34	8	24.5
ARCTIC TOKYO	LIBERIAN	2	53.7 N	176.5 W	12	03	M 36	2 NM	56	1006.0	2.0	2.0	4	6.5			
SEALAND PIONEER	AMERICAN	2	47.1 N	156.2 E	00	28	M 48	5 NM	02	989.5	3.0	0.0	6	11.5	28	7	19.5
VIOLET	LIBERIAN	2	33.7 N	164.9 E	06	21	M 36	.25 NM	65	1000.5	19.0	21.0	2	6.5	23	< 6	10
AMERICA SUN	AMERICAN	2	59.4 N	144.7 W	06	11	41	10 NM	03	1008.1	8.0	5.0	6	8			
AMER LANCER	AMERICAN	2	46.3 N	171.2 W	00	28	45	5 NM	02	1010.2	5.0	6.7	3	14.5	34	12	26
RED ARROW	LIBERIAN	2	44.9 N	167.7 W	00	28	M 50	5 NM	02	1009.0	5.0	6.1	10	19.5	27	12	19.5
HONSHU GLORIA	LIBERIAN	2	45.2 N	152.6 E	00	29	M 42	5 NM	03	1006.0	3.0	2.0	5	5	26	< 6	5
AMERICA SUN	AMERICAN	3	52.8 N	137.0 W	12	14	M 35	2 NM	60	993.9	8.4	6.7	3	6.5	14	8	13
ALASKA STANDARD	AMERICAN	3	56.6 N	156.4 W	12	07	40	10 NM	65	993.4	4.4	4.4	5	13			
BREWSTER	PANAMANIAN	3	37.8 N	161.0 E	00	18	M 40	2 NM	02	1008.4	17.5	13.0	2	5	32	7	14.5
KOFUKU MARU	JAPANESE	3	43.4 N	163.4 W	00	23	M 40	5 NM	60	991.5	8.0	8.0	7	14.5			
GREAT OCEAN	JAPANESE	3	48.5 N	138.3 W	05	27	M 40	5 NM	60	999.7	8.5	9.0	6	11.5	22	7	11.5
RED ARROW	LIBERIAN	4	42.2 N	153.2 W	00	29	M 20	5 NM	50	996.0	11.0	10.5	12	19.5	29	>13	26
BREWSTER	PANAMANIAN	4	38.5 N	154.5 E	12	29	M 35	5 NM	01	1017.0	11.0	17.0	2	3			
PACIFIC ARROW	JAPANESE	4	36.8 N	152.3 W	00	27	M 34	5 NM	81	1003.5	15.0	14.2	10	19.5	32	>13	26
KOFUKU MARU	JAPANESE	4	40.1 N	170.9 W	18	24	M 40	1 NM	80	1004.0	13.0	11.5	6	13			
KOFUKU MARU	JAPANESE	5	39.9 N	172.4 W	00	28	M 35	5 NM	03	1010.5	11.0	11.0	6	16.5			
PRES MONROE	AMERICAN	5	31.4 N	135.3 E	12	07	40	5 NM	02	1019.3	20.6	17.8	6	6.5	07	7	8
LAUREL	LIBERIAN	5	33.2 N	135.1 E	00	07	M 40	10 NM	02	1020.0	22.0	19.0	5	13	07	< 6	14.5
MODOC	AMERICAN	5	42.9 N	124.6 W	03	17	M 45	1 NM	62	1003.7	11.5	14.2	5	8	17	6	11.5
CORNUCOPIA	AMERICAN	5	42.0 N	126.0 W	00	16	M 35	.25 NM	82	1008.5	11.7	14.0	3	5	15	6	10
ORIENTAL EXECUTIVE	LIBERIAN	6	34.0 N	169.1 E	18	34	M 35	5 NM	02	1018.0	16.0						
ARCO PRUDHOE BAY	AMERICAN	7	48.2 N	133.1 W	12	31	M 35	5 NM	82	998.5	9.0	5.6		5	31	X	13
ATLANTIC PIONEER	PANAMANIAN	7	44.3 N	157.2 E	12	18	M 36	10 NM	05	1016.5	5.0	2.0					
AMERICA SUN	AMERICAN	8	40.3 N	125.2 W	12	32	35	5 NM	60	1024.0	12.0	13.5			32	9	19.5
ROSE	LIBERIAN	8	37.6 N	169.4 W	12	34	M 35	2 NM	10	1014.0	9.8	16.0					
PACIFIC WING	PANAMANIAN	8	45.5 N	127.2 W	12	35	M 40	5 NM	03	1014.0	12.0	11.0	5	18	36	7	14.5
OVERSEAS JUNEAU	AMERICAN	8	44.7 N	128.6 W	12	30	36	5 NM	02	1013.2	9.5	9.0	4	13	32	9	14.5
GENEVIEVE LYKES	AMERICAN	8	34.5 N	145.5 E	06	17	37	10 NM	02	1014.7	17.8	16.7	6	10	17	9	11.5
THOMPSON PASS	AMERICAN	9	53.2 N	138.0 W	22	14	50	.5 NM	64	995.5	12.0	8.3	7	24.5			
TOYOTA MARU # 10	JAPANESE	9	52.2 N	141.1 W	18	14	M 35	1 NM	01	992.5	8.5	9.0	3	6.5	16	7	16.5
SEA FAN	SINGAPORE	9	42.6 N	147.6 E	05	14	M 49	< 50 YD	46	1000.0	6.2	3.9	6	13			
AMER TRADER	AMERICAN	9	36.2 N	126.1 W	00	32	35	> 25 NM	02	1020.0	12.8	14.5	6	8	30	9	26
AMERICA SUN	AMERICAN	9	43.4 N	127.7 W	06	32	M 40	5 NM	01	1027.7	11.5	10.6	2	5	32	8	19.5
ARCO ANCHORAGE	AMERICAN	9	43.5 N	127.8 W	06	35	M 35	10 NM	01	1022.0	14.8	10.0			33	X	5
ATLANTIC PIONEER	PANAMANIAN	9	39.6 N	148.9 E	00	19	M 42	.5 NM	81	1004.3	13.0	9.0	9	16.5	23	>13	19.5
PORTLAND	AMERICAN	9	55.0 N	143.7 W	18	09	45	1 NM	65	993.2	3.3	6.7			09	13	18
GOLDEN GATE BRIDGE	JAPANESE	9	39.5 N	158.0 W	00	19	M 40	10 NM	03	1011.0	15.0	13.0	6	11.5	22	7	11.5
CORNUCOPIA	AMERICAN	9	39.9 N	124.7 W	18	35	35	10 NM	01	1019.6	13.3	11.7	2	6.5	33	6	14.5
PACIFIC WING	PANAMANIAN	9	44.8 N	130.7 W	00	34	M 36	10 NM	02	1025.0	12.0	10.0	5	13			
B T ALASKA	AMERICAN	10	52.7 N	137.0 W	12	25	45	2 NM	02	996.0	5.5	7.2	14	13			
GEMINI	LIBERIAN	10	52.3 N	140.8 W	12	27	M 50	5 NM	07	999.0	7.0	4.0	7	11.5	20	7	11.5
GOLDEN GATE BRIDGE	JAPANESE	10	39.1 N	167.5 W	00	24	M 37	10 NM	02	1019.5	13.0	13.0	3	8	25	7	8
EXXON SAN FRANCISCO	AMERICAN	10	54.0 N	136.9 W	00	14	45	5 NM	80	993.9	11.0	5.5	8	19.5			
GLACIER BAY	AMERICAN	10	54.8 N	148.8 W	06	32	37	2 NM	02	999.8	5.0	3.9	7	10			
KOFUKU MARU	JAPANESE	10	36.5 N	154.6 E	00	18	M 35	.5 NM	47	1010.0	18.0	13.5	5	11.5			
PRES PIERCE	AMERICAN	10	51.1 N	144.1 W	06	28	35	5 NM	05	1000.0	7.2	6.1	9	6.5	29	9	11.5
PORTLAND	AMERICAN	10	52.6 N	137.8 W	12	29	47	2 NM	10	996.4	5.0	6.7	7	19.5	27	13	19.5
AMERICA SUN	AMERICAN	10	48.8 N	132.5 W	06	20	M 45	2 NM	50	1011.9	9.7	6.2	4	6.5	21	7	16.5
ARCO ANCHORAGE	AMERICAN	10	49.0 N	134.4 W	12	27	M 35	5 NM	02	1014.5	8.3	6.2	6	10			
TOYOTA MARU # 10	JAPANESE	10	53.0 N	144.8 W	03	28	M 55	2 NM	65	983.0	7.0	7.0	5	8	29	8	13
PRES KENNEDY	AMERICAN	10	52.6 N	177.0 E	06	32	38	5 NM	02	1012.5	1.5	2.8	5	8	27	8	8
PRINCE WILLIAM SOUND	AMERICAN	10	52.2 N	138.3 W	17	25	M 45	2 NM	07	1008.2	8.8	7.8	5	18	25	12	50.5
PACIFIC WING	PANAMANIAN	10	43.0 N	140.1 W	00	27	M 36	2 NM	63	1018.5	15.5	10.5	4	10			
GEMINI	LIBERIAN	11	52.8 N	143.5 W	00	26	M 36	10 NM	02	1014.0	7.2	4.0	9	14.5			
GREAT LAND	AMERICAN	11	54.1 N	137.7 W	00	24	M 35	5 NM	02	1011.5	9.5	7.2		5	25	11	19.5
KOFUKU MARU	JAPANESE	11	35.2 N	144.0 E	18	23	M 35	5 NM	02	1000.0	19.0	19.0	6	3			
AMERICA SUN	AMERICAN	11	52.6 N	136.5 W	06	27	M 45	3 NM	02	1023.0	8.5	7.7	4	10	27	7	16.5
PRINCE WILLIAM SOUND	AMERICAN	11	52.0 N	136.4 W	00	24	M 20	5 NM	01	1018.0	8.9	7.2	5	14.5	26	12	32.5
SEA FAN	SINGAPORE	12	46.0 N	166.6 E	03	14	M 45	< 50 YD	46	999.9	6.8	3.9	7	13			
SEALAND TRADE	AMERICAN	12	39.0 N	150.9 E	12	36	35	5 NM	15	985.7	9.7	8.9	7	6.5			
YOUNG SEAGULL	LIBERIAN	12	39.2 N	149.9 E	18	34	M 42	1 NM	01	1001.0	8.0	10.0	7	13	34	10	16.5
GREAT OCEAN	JAPANESE	12	40.3 N	148.5 E	11	34	M 35	.5 NM	61	998.0	6.5	12.0	6	8			
PRINCE WILLIAM SOUND	AMERICAN	13	39.2 N	125.6 W	12	35	M 35	10 NM	03	1021.2	13.2	13.7	6	8	33	10	11.5
SPRUCE	JAPANESE	13	44.0 N	176.2 E	12	12	M 35	5 NM	02	1000.0	7.0	7.5	8	13	30	7	11.5
ZIM MONTREAL	LIBERIAN	13	36.2 N	162.0 E	06	23	M 40	2 NM	02	1000.0	15.0		4	16.5	24	10	16.5
SEA FAN	SINGAPORE	13	47.8 N	172.0 E	03	14	M 39	2 NM	03	1000.9	7.8	3.9	5	10			
CRESSIDA	PANAMANIAN	13	40.7 N	154.4 E	12	36	M 28	1 NM	05	1005.0	3.0	0.1	7	23	03	7	26
HONSHU GLORIA	LIBERIAN	13	46.4 N	169.7 E	18	08	M 46	5 NM	10	993.5	3.0	4.0	6	19.5			
PRES JEFFERSON	AMERICAN	13	47.9 N	172.8 E	18	07	46	2 NM	63	995.3	4.4	1.1	3	8	07	7	13
ARILD MAERSK	DANISH	13	33.3 N	156.5 E	00	27	35	10 NM	01	1008.0	18.5	13.0			27	7	28

Vessel	Nationality	Date	Position of Ship Lat. deg.	Position of Ship Long. deg.	Time GMT	Wind Dir. 10°	Wind Speed kt.	Visibility n. mi.	Present Weather code	Pressure mb.	Temperature °C. Air	Temperature °C. Sea	Sea Waves† Period sec.	Sea Waves† Height ft.	Swell Waves Dir. 10°	Swell Waves Period sec.	Swell Waves Height ft.
NORTH PACIFIC OCEAN		MAY															
PRES KENNEDY	AMERICAN	14	35.9 N	141.8 E	12	22	36	5 NM	02	1008.5	15.0	17.2					
SEA FAN	SINGAPORE	14	49.6 N	178.7 E	03	12	M 48	50 YD	05	999.9	4.2	4.1	6	16.5			
PRES JEFFERSON	AMERICAN	14	48.4 N	175.6 E	00	06	M 55	2 NM	68	992.2	5.0	1.1	6	14.5	09	9	19.5
HONSHU GLORIA	LIBERIAN	14	46.7 N	171.1 E	00	06	M 42	2 NM	10	991.5	3.0	4.5	6	16.5			
PRES JOHNSON	AMERICAN	15	37.3 N	143.5 E	06	06	30	2 NM	10	1001.5	13.3	15.6	4	16.5	06	< 6	29.5
AMERICA SUN	AMERICAN	15	55.0 N	139.5 W	06	09	M 35	5 NM	02	1010.5	6.2	5.7	2	10	08	7	14.5
SINCERE 3	LIBERIAN	15	52.2 N	174.6 E	12	01	M 35	2 NM	10	1000.0	2.0	4.0					
INGER	AMERICAN	15	39.1 N	124.2 W	06	33	35	10 NM	02	1011.0	11.7	10.6	3	5			
HONSHU GLORIA	LIBERIAN	15	48.6 N	176.2 W	18	26	M 36	1 NM	28	985.5	4.5	5.0	3	8	26	< 6	10
STAR DIEPPE	NORWEGIAN	16	51.6 N	164.9 W	12	23	30	10 NM	03	985.0	5.2						
															24	X	29.5
SEALAND TRADE	AMERICAN	16	49.3 N	158.8 W	06	23	35	5 NM	15	999.4	6.9	4.4	5	6.5	26	9	11.5
SEALAND COMMERCE	AMERICAN	16	53.1 N	179.2 W	18	33	35	5 NM	01	999.7	3.6	1.9	6	11.5	28	7	6.5
VIOLET	LIBERIAN	16	45.9 N	171.1 W	06	30	M 35	2 NM	02	1003.0	5.0	7.0	4	6.5	23	< 6	16.5
PRES PIERCE	AMERICAN	16	54.0 N	158.3 W	12	24	40	5 NM	21	984.4	4.4	4.4					
CORNUCOPIA	AMERICAN	16	58.1 N	149.7 W	18	11	M 38	5 NM	58	993.0	4.4	5.5	2	5	12	6	10
BEISHU MARU	JAPANESE	16	52.2 N	156.4 W	06	21	M 37	2 NM	15	992.0	5.3	7.0	6	10	23	7	13
PRES PIERCE	AMERICAN	17	54.5 N	165.5 W	00	32	40	5 NM	02	986.8	8.3	4.4	5	5			
STAR DIEPPE	NORWEGIAN	17	51.1 N	168.9 W	00	29	20	.5 NM	43	995.0	6.3			13	24	X	29.5
SEATRAIN VALLEY FORGE	SINGAPORE	17	33.8 N	148.5 E	12	20	M 48	5 NM	10	1008.5	20.8	18.0					
SUCCESSFUL VENTURE	LIBERIAN	17	42.5 N	150.9 E	00	07	M 35	.5 NM	83	996.0	0.0	2.0	6	11.5	27	9	16.5
VIOLET	LIBERIAN	17	47.4 N	164.1 W	00	22	M 35	5 NM	51	1006.0	7.0	7.0	6	6.5	24	8	11.5
HONSHU GLORIA	LIBERIAN	17	49.5 N	161.6 W	12	24	M 47	5 NM	51	1004.0	6.0	6.5					
SINCERE 3	LIBERIAN	18	46.4 N	152.1 E	12	28	M 35	.25 NM	63	999.3	1.0	2.0					
SEATRAIN PRINCETON	GERMAN	18	22.5 N	125.5 E	06	06	37	5 NM	50	1009.5	22.0	25.0	7	13			
STAR DIEPPE	NORWEGIAN	18	50.3 N	175.6 E	18	16	40	1 NM		991.5	4.0			8			
SEALAND COMMERCE	AMERICAN	18	45.8 N	157.0 E	18	27	60	2 NM	02	990.5	2.2	1.1	8	37.5			
PRES PIERCE	AMERICAN	18	52.6 N	168.2 E	18	16	40	5 NM	02	996.5	4.5	2.8	3	5	16	6	11.5
ARCTIC TOKYO	LIBERIAN	18	45.2 N	158.9 E	18	26	M 45	2 NM	10	997.0	4.0	2.0	6	19.5			
PRES MCKINLEY	AMERICAN	18	40.8 N	127.1 W	18	36	42	10 NM	07	1024.0	13.4	10.6	8	10	36	6	13
NOPAL BRANCO	NORWEGIAN	18	44.4 N	174.3 E	23	21	M 45	1 NM	10	1002.0	8.5	6.5	5	8	20	7	16.5
GEMINI	LIBERIAN	18	45.6 N	154.0 E	06	25	M 30	.5 NM	10	979.0	5.3	- 2.0	7	13	23	7	13
GENISTA	LIBERIAN	18	50.4 N	168.7 E	18	22	M 42	.25 NM	45	997.1	6.0	6.0	5	13			
GOLDEN EXPLORER	LIBERIAN	18	45.4 N	158.4 E	22	27	M 30	5 NM	05	999.0	3.0	2.0	8	26	23	7	23
POLAR ALASKA	LIBERIAN	19	51.3 N	167.0 E	18	32	M 50	1 NM	25	984.0	3.0	2.0	5	8			
NOPAL BRANCO	NORWEGIAN	19	43.9 N	170.4 E	12	26	M 45	5 NM	50	1002.0	7.0	7.0	5	10	26	7	16.5
GOLDEN EXPLORER	LIBERIAN	19	47.0 N	166.3 E	22	29	M 30	5 NM	05	1006.0	4.0	3.0	8	26	27	6	19.5
GENISTA	LIBERIAN	19	49.5 N	165.8 E	06	27	M 51	.25 NM	45	997.2	3.0	4.0	8	31			
ARCO FAIRBANKS	AMERICAN	19	41.5 N	126.7 W	00	36	M 46	10 NM	01	1023.0	12.3	12.3	5	11.5			
B T ALASKA	AMERICAN	19	39.9 N	125.7 W	00	35	35	5 NM	01	1018.0	12.7	12.7	9	10			
ALEUTIAN DEVELOPER	AMERICAN	19	56.4 N	165.2 W	18	14	M 38	5 NM	51	1001.0	3.3	3.9	4	8	14	7	14.5
PRES PIERCE	AMERICAN	19	50.2 N	162.7 E	06	34	40	1 NM		982.1	3.0	2.1	3	8	34	7	14.5
STAR DIEPPE	NORWEGIAN	19	50.0 N	174.3 E	06	22	50	1 NM	80	973.0	3.0				22	X	26
SUNNY PIONEER	PANAMANIAN	19	52.9 N	163.9 W	18	18	M 43	1 NM	80	1006.8	6.4	4.0	9	8			
ARCTIC TOKYO	LIBERIAN	19	46.0 N	161.1 E	00	24	M 40	.5 NM	10	998.5	5.0	2.0	6	19.5			
JARVIS	AMERICAN	19	52.2 N	173.2 W	09	18	M 38	2 NM	03	994.1	4.0	4.5	6	8			
SHUNWIND	LIBERIAN	19	52.4 N	163.7 E	06	01	41	1 NM	10	969.5	2.5	4.0	5	11.5			
VERRAZANO BRIDGE	JAPANESE	19	35.8 N	128.5 W	00	35	M 36	10 NM	02	1019.0	18.5	14.0	5	18	02	7	6.5
NORTH STAR III	AMERICAN	20	59.1 N	166.6 W	06	13	M 43	5 NM	50	995.7	4.0	3.3	5	11.5	18	7	18
CHESTNUT HILL	AMERICAN	20	47.2 N	163.9 W	18	24	40	2 NM	01	995.6	6.7	5.5	3	10			
SUNNY PIONEER	PANAMANIAN	20	53.2 N	162.3 W	00	19	M 36	2 NM	02	1005.5	6.7	4.0	8	8	19	11	8
QUEENS WAY BRIDGE	JAPANESE	20	39.4 N	176.5 W	12	30	M 36	10 NM	02	1015.0	11.0		3	6.5	27	7	10
STAR DIEPPE	NORWEGIAN	20	49.6 N	173.0 E	06	29	45	2 NM	80	992.3	4.5				29	X	23
PRES EISENHOWER	AMERICAN	20	21.2 N	120.1 E	00	06	35	2 NM	03	1010.7	24.4	27.2	5	8	06	6	11.5
ARCO PRUDHOE BAY	AMERICAN	20	44.2 N	127.8 W	12	36	M 40	2 NM	01	1015.9	12.3	11.7	5	8	34	< 6	11.5
ARCTIC TOKYO	LIBERIAN	20	50.2 N	169.6 E	06	27	M 42	2 NM	10	1001.0	5.0	2.0	5	19.5	32	10	23
TRIUMPH	PANAMANIAN	20	45.8 N	169.3 W	00	21	M 36	1 NM	21	1002.5	7.0	7.0	5	13	21	10	14.5
CHESTNUT HILL	AMERICAN	21	46.0 N	164.7 W	06	27	40	5 NM	03	998.3	6.7	5.5	3	8			
TRIUMPH	PANAMANIAN	21	44.4 N	173.5 W	00	28	M 40	2 NM	02	1006.4	5.5	8.0	5	13	27	11	16.5
NEWARK	AMERICAN	24	53.5 N	139.2 W	06	16	35	2 NM	20	1001.0	7.2	7.8	3	8	16	< 6	16.5
CHESTNUT HILL	AMERICAN	24	37.9 N	170.0 E	18	24	40	5 NM	02	1006.4	13.9	12.8	3	16.5			
TRIUMPH	PANAMANIAN	24	41.1 N	165.5 E	06	12	M 40	.25 NM	60	995.0	10.0	12.0	6	13	12	10	16.5
AMERICA SUN	AMERICAN	24	54.8 N	139.1 W	06	12	M 36	2 NM	51	1002.6	7.3	6.7	3	6.5	16	7	8
AMER RELIANCE	AMERICAN	24	42.0 N	172.5 E	23	26	45	2 NM	02	992.6	9.4	5.6	3	16.5	24	8	19.5
CHAVEZ	PANAMANIAN	25	39.2 N	124.2 W	05	33	40	5 NM	07	1015.5	15.5	9.4	5	13	33	6	21
ARCO FAIRBANKS	AMERICAN	25	38.6 N	124.2 W	00	32	M 40	5 NM	00	1014.5	17.8	17.8	7	8			
GLACIER BAY	AMERICAN	25	59.2 N	144.6 W	00	09	35	2 NM	02	1001.0	6.6	5.0	8	14.5			
AMER RELIANCE	AMERICAN	25	42.1 N	172.0 E	06	23	45	1 NM		995.5	9.4	6.1	5	23			
AMER AQUARIUS	AMERICAN	25	40.9 N	179.8 E	00	16	35	2 NM	03	1012.2	10.0	11.2	6	10	16	10	14.5
PRES MONROE	AMERICAN	26	33.0 N	173.2 E	12	30	35	5 NM	02	1011.2	15.6	17.8	5	5	29	6	8
EXPORT COURIER	AMERICAN	26	41.0 N	168.5 E	00	31	40	10 NM	02	1011.0	6.7	10.0	8	32.5	31	11	32.5
UNITED SEA ANGEL	PANAMANIAN	26	47.0 N	145.1 W	12	26	M 35	10 NM	03	1017.5	8.5	10.0	6	11.5	26	10	23
AMER RELIANCE	AMERICAN	26	40.8 N	176.0 E	06	31	45	5 NM	02	997.5	8.9	6.1	8	24.5			
CHEVRON COLORADO	AMERICAN	27	38.4 N	124.0 W	18	32	M 45	10 NM	02	1014.0	16.7		2	8	32	< 6	14.5
CHEVRON CALIFORNIA	AMERICAN	27	36.5 N	122.9 W	18	34	35	5 NM	01	1016.0	13.9	10.6	3	10	34	8	19.5
CALIFORNIAN	AMERICAN	27	36.9 N	125.7 W	18	01	38	10 NM	02	1021.0	13.9	15.0	5	13	02	8	16.5
CHEVRON WASHINGTON	AMERICAN	27	39.5 N	125.0 W	00	35	M 38	5 NM	01	1017.5	14.0		4	5	30	9	11.5
LAUREL	LIBERIAN	27	40.3 N	160.2 W	00	15	M 35	1 NM	54	1009.0	14.0	10.0	6	11.5	16	9	11.5
HONSHU GLORIA	LIBERIAN	27	49.2 N	143.0 W	12	28	M 36	> 25 NM	02	1022.5	8.0	10.0					
EXPORT COURIER	AMERICAN	27	39.4 N	174.3 E	00	32	25	10 NM	02	1013.6	10.6	11.1	8	19.5	32	11	26
SEALAND ADVENTURER	AMERICAN	27	36.3 N	125.0 W	18	34	M 35	10 NM	03	1024.0	17.0	14.0	4	10	34	< 6	16.5
ROSE	LIBERIAN	27	34.6 N	122.1 W	06	32	M 37	5 NM	03	1012.5	14.0	16.0					
AMER RELIANCE	AMERICAN	27	39.5 N	176.5 W	06	30	35	5 NM	51	1004.0	10.6	12.2	5	13			
CHEVRON COLORADO	AMERICAN	28	38.9 N	124.2 W	00	33	M 45	5 NM	03	1014.2	10.7		4	8	32	7	16.5
ARCO ANCHORAGE	AMERICAN	28	37.3 N	123.2 W	06	33	M 35	10 NM	02	1014.0	10.6	8.8	7	16.5	33	6	18
GOLDEN DAISY	LIBERIAN	28	49.4 N	158.0 W	00	10	M 39	5 NM	51	1005.0	8.5	5.0	10	19.5			
UNITED SEA ANGEL	PANAMANIAN	28	48.9 N	158.4 W	06	11	M 27	2 NM	10	1001.3	9.0	7.0	9	16.5	11	9	26
PRES POLK	AMERICAN	29	35.6 N	123.5 W	06	34	35	10 NM	01	1017.5	12.3	12.3	3	6.5	32	6	13
PRES VAN BUREN	AMERICAN	29	37.9 N	172.7 W	18	29	35	5 NM	16	1004.0	12.8	12.8	3	6.5	28	8	13
EXXON SAN FRANCISCO	AMERICAN	29	41.4 N	126.2 W	18	36	35	10 NM	02	1025.4	14.5	12.2	5	19.5	35	9	23
PRINCE WILLIAM SOUND	AMERICAN	29	37.0 N	124.2 W	06	34	M 35	10 NM	02	1019.2	11.7	12.7					
CORNUCOPIA	AMERICAN	30	42.2 N	120.1 W	18	01	38	10 NM	03	1024.0	13.4	12.8	2	5	02	6	10
AMER RELIANCE	AMERICAN	30	40.3 N	146.6 W	18	17	45	2 NM	63	1008.5	16.1	12.8	5	19.5			
ARCO JUNEAU	AMERICAN	30	41.2 N	126.8 W	18	33	M 40	10 NM	03	1020.0	19.7	6.1	4	10	02	7	14.5
PRES JOHNSON	AMERICAN	31	50.8 N	142.6 W	12	13	35	2 NM	63	1009.0	11.1	7.1	3	6.5	13	< 6	13
JARVIS	AMERICAN	31	56.9 N	152.5 W	12	05	M 37	2 NM	02	1012.5	7.5	6.5	6	6.5			
ALEUTIAN DEVELOPER	AMERICAN	31	56.5 N	153.7 W	12	05	M 44	2 NM	02	1006.4	7.8	5.0	4	18	07	6	19.5
EXPORT COURIER	AMERICAN	31	40.1 N	147.4 W	06	20	20	5 NM	20	1008.0	15.6	13.4	4	8	20	> 13	26

Vessel	Nationality	Date	Position of Ship: Lat. deg.	Position of Ship: Long. deg.	Time GMT	Wind: Dir. 10°	Wind: Speed kt.	Visibility n. mi.	Present Weather code	Pressure mb.	Temperature °C: Air	Temperature °C: Sea	Sea Waves+: Period sec.	Sea Waves+: Height ft.	Swell Waves: Dir. 10°	Swell Waves: Period sec.	Swell Waves: Height ft.
NORTH PACIFIC OCEAN		MAY															
ENVIRONMENTAL BUOYS																	
46001	AMERICAN	10	56.0N	148.0W	03	36	M 37			993.6	4.0	5.6	6	13			
46004	AMERICAN	3	51.0N	136.0W	10	16	M 35			999.2	8.6	7.6					
46004	AMERICAN	10	51.0N	136.0W	06	23	M 39			998.4	7.3	7.3	9	18			
NORTH PACIFIC OCEAN		JUNE															
ARCO SAG RIVER	AMERICAN	1	56.9 N	141.0 W	06	13	M 36	2 NM	01	1012.8	8.9	7.8	2	6.5	13	6	10
EXXON PHILADELPHIA	AMERICAN	1	56.9 N	142.0 W	00	13	35	2 NM	12	1013.9	10.0	7.3	2	3	12	6	6.5
PRES TRUMAN	AMERICAN	2	42.5 N	128.5 W	00	36	35	10 NM	05	1022.0	14.4	12.7	2	5	34	< 6	8
TEXACO GEORGIA	AMERICAN	3	17.0 N	101.1 W	23	12	77	< 50 YD	65	1003.1	23.9	27.3	8	10	12	12	29.5
OVERSEAS ALEUTIAN	AMERICAN	3	15.4 N	98.1 W	12	14	45	.25 NM	82	1003.0	22.7	30.5	10	14.5	18	12	19.5
ATLANTIC PIONEER	PANAMANIAN	3	52.6 N	148.6 W	00	17	M 38	1 NM	11	996.2	8.0	6.0	5	8	17	< 6	10
SPRUCE	JAPANESE	4	49.7 N	164.9 E	06	30	M 38	2 NM	05	1007.8	4.8	4.5	8	11.5	12	8	11.5
ALASKA STANDARD	AMERICAN	4	58.7 N	150.4 W	00	06	35	5 NM	50	995.7	8.8	5.0	3	6.5	08	< 6	10
TEXACO GEORGIA	AMERICAN	4	17.1 N	101.4 W	03	17	60	< 50 YD	65	997.6	23.9	27.3					
MAMMOTH FIR	LIBERIAN	4	18.8 N	104.9 W	00	30	M 35	10 NM	02	1006.6	26.8	30.0	4	13	26	7	6.5
CORNUCOPIA	AMERICAN	4	41.6 N	126.4 W	06	36	35	.5 NM	45	1016.9	12.2	12.8	2	5	36	6	10
SPRUCE	JAPANESE	5	44.9 N	154.7 E	18	24	M 35	.25 NM	45	1018.5	6.0	5.5	6	11.5	06	6	11.5
ARCO PRUDHOE BAY	AMERICAN	5	48.2 N	131.0 W	00	20	M 35	2 NM	58	1004.9	13.4	10.5	4	19.5	22	< 6	28
AMERICA SUN	AMERICAN	5	52.3 N	136.2 W	06	28	39	5 NM	07	999.9	8.9	8.9	3	6.5	26	9	11.5
CORNUCOPIA	AMERICAN	5	47.4 N	131.7 W	06	27	40	10 NM	01	1011.5	11.2	12.2	2	5	27	< 6	8
SPRUCE	JAPANESE	6	43.2 N	151.4 E	06	20	M 38	200 YD	45	1018.0	9.0	8.5	6	11.5	02	6	11.5
DIANA PROSPERITY	SINGAPORE	6	34.0 N	124.4 W	23	36	38	5 NM	05	1014.5	16.2	14.0	5	16.5	36	9	13
AMER TRADER	AMERICAN	7	38.6 N	125.5 W	18	36	45	10 NM	00	1017.5	12.8	14.0	3	10	36	< 6	19.5
ARCO PRUDHOE BAY	AMERICAN	7	36.3 N	122.5 W	12	35	M 35	5 NM	02	1009.0	12.5	12.5	3	8	35	6	13
AVILA	AMERICAN	7	36.2 N	121.9 W	01	32	35	10 NM	05	1005.1	13.9	13.3	4	13	31	6	16.5
ASHLEY LYKES	AMERICAN	7	36.8 N	124.7 W	23	34	39	5 NM	02	1014.0	12.3	13.3	7	11.5	34	8	21
SEALAND EXCHANGE	AMERICAN	7	38.3 N	123.6 W	06	35	35	5 NM	02	1011.8	11.7	8.9	2	5	34	6	10
VANGUARD	LIBERIAN	7	48.8 N	126.1 W	00	30	M 35	5 NM	01	1021.0	17.0	12.0	5	10	30	6	13
JOHN TYLER	AMERICAN	7	35.4 N	124.6 W	18	35	40	10 NM	00	1013.9	14.4	14.4	7	16.5	34	11	29.5
EXXON PHILADELPHIA	AMERICAN	7	39.4 N	124.6 W	18	34	40	5 NM	02	1015.0	11.7	9.4	6	10	33	11	14.5
EXXON SAN FRANCISCO	AMERICAN	7	39.5 N	124.7 W	13	33	35	10 NM	05	1014.6	12.0						
MATSONIA	AMERICAN	7	36.5 N	124.5 W	12	01	40	10 NM	00	1014.0	12.8	15.0	4	13			
CHEVRON CALIFORNIA	AMERICAN	7	43.4 N	125.3 W	06	36	40	10 NM	02	1026.0	13.9	8.9	2	10	35	6	11.5
DIANA PROSPERITY	SINGAPORE	7	34.0 N	123.4 W	05	36	38	5 NM	07	1011.5	16.1	14.0	XX	19.5	36	8	24.5
ALLTRANS EXPRESS	SINGAPORE	7	37.1 N	126.7 W	18	36	M 45	5 NM	02	1018.0	14.5	14.4	7	19.5	36	10	26
AMERICA MARU	JAPANESE	7	35.9 N	125.0 W	18	33	M 39	5 NM	02	1014.5	13.5	15.0	5	11.5	35	12	16.5
FRIENDSHIP	LIBERIAN	8	35.3 N	125.5 W	00	01	M 36	5 NM	02	1013.5	14.5	16.5	7	10	01	10	16.5
JOHN TYLER	AMERICAN	8	36.9 N	127.5 W	06	36	28	10 NM	02	1020.3	13.3	15.0	5	11.5	35	8	24.5
EXXON PHILADELPHIA	AMERICAN	8	39.8 N	125.0 W	00	35	35	5 NM	05	1017.2	14.0	9.4	4	5	36	8	18
ALLTRANS EXPRESS	SINGAPORE	8	37.9 N	128.8 W	00	02	M 35	10 NM	02	1022.0	15.0	15.0	7	23	36	10	23
ARCO JUNEAU	AMERICAN	8	41.9 N	127.3 W	00	01	M 36	> 25 NM	01	1025.6	14.4	10.0	3	5	33	< 6	6.5
PRES TRUMAN	AMERICAN	8	49.3 N	161.3 E	18	19	35	2 NM	62	1009.1	3.3	2.8	2	6.5	25	< 6	8
MIDAS RHEIN	LIBERIAN	9	38.6 N	129.4 W	06	06	M 36	5 NM	02	1022.0	13.0	15.0	6	10			
AVESTA	SWEDISH	9	42.2 N	159.0 E	12	26	M 40	2 NM	10	998.0	9.0						
ROSE	LIBERIAN	9	39.5 N	158.4 E	06	23	M 35	1 NM	10	1005.5	17.8	14.5					
SEALAND FINANCE	AMERICAN	9	43.3 N	152.1 E	06	33	35	.5 NM	44	1003.5	6.1	2.2	4	6.5	33	7	18
PRES JOHNSON	AMERICAN	9	50.1 N	168.0 E	12	18	35	2 NM	63	1009.2	6.7	3.4	4	8	21	6	14.5
GEMINI	LIBERIAN	10	46.5 N	165.3 E	06	34	M 35	1 NM	10	1004.0	5.2	2.0	7	11.5			
SEALAND ADVENTURER	AMERICAN	10	47.7 N	169.3 E	00	18	M 37	1 NM	61	1001.0	7.0	5.0	2	8	18	7	11.5
WESTWARD VENTURE	AMERICAN	11	58.2 N	148.5 W	18	29	M 35	> 25 NM	00	1021.7	14.4	6.7	3	5			
GEMINI	LIBERIAN	11	48.2 N	172.5 E	06	08	M 36	.5 NM	44	1015.0	8.0	1.5	8	13	11	8	13
SEALAND COMMERCE	AMERICAN	12	39.1 N	124.2 W	06	35	35	10 NM	01	1017.0	10.0	7.2	6	8	35	7	13
ARCO PRUDHOE BAY	AMERICAN	13	38.7 N	124.1 W	00	31	M 35	10 NM	02	1015.8	14.0	11.1	3	19.5	32	< 6	23
SUNNY PIONEER	PANAMANIAN	13	42.7 N	152.9 E	00	28	M 36	2 NM	03	1001.8	8.5	8.0	6	8			
BLUE OCEAN	JAPANESE	15	50.8 N	177.1 E	12	24	M 35	1 NM		1006.0	7.0	6.0	9	10			
AUSTRAL MOON	AMERICAN	15	26.3 N	147.1 W	00	08	35	10 NM	03	1022.5	21.1	22.2	5	14.5	05	>13	28
ATLANTIC PIONEER	PANAMANIAN	16	53.1 N	148.7 W	00	23	M 35	2 NM	03	1018.5	10.0	9.0	3	5	25	< 6	8
ARCO ANCHORAGE	AMERICAN	17	35.1 N	121.4 W	06	32	M 45	10 NM	01	1015.0	15.0	14.5	5	10			
ATLANTIC PIONEER	PANAMANIAN	17	52.2 N	161.4 W	12	25	M 35	5 NM	03	1017.0	8.0	7.0	6	14.5			
AUSTRAL MOON	AMERICAN	17	39.3 N	136.2 W	00	32	28	10 NM	18	1028.3	15.7	15.7	6	8	32	7	24.5
SEALAND PIONEER	AMERICAN	17	39.3 N	128.2 W	06	33	M 35	10 NM	02	1020.0	15.0	12.0	5	5	31	< 6	10
ORIENTAL EDUCATOR	LIBERIAN	18	36.4 N	144.0 E	18	23	M 39	10 NM	02	1012.0	22.5	24.0					
PRES JEFFERSON	AMERICAN	18	50.2 N	130.0 W	18	32	M 35	10 NM	01	1019.4	15.0	12.2	4	5	30	7	8
BLUE OCEAN	JAPANESE	20	38.2 N	144.2 E	18	19	M 35	5 NM	03	1008.0	24.5	23.0	9	10			
KOPAA	AMERICAN	21	37.7 N	123.4 W	00	33	35	10 NM	02	1019.0	13.4	18.4	5	6.5	36	9	6.5
PRINCE WILLIAM SOUND	AMERICAN	21	39.6 N	124.5 W	00	33	M 35	10 NM	02	1017.2	15.6	11.2	9	10			
ARCO SAG RIVER	AMERICAN	22	35.7 N	121.9 W	00	31	M 37	5 NM	02	1017.9	14.0	13.4	4	5	32	< 6	8
PRES KENNEDY	AMERICAN	22	40.6 N	172.2 E	00	22	35	5 NM	50	1020.2	16.1	13.3	4	5			
AMER LIBERTY	AMERICAN	23	37.0 N	124.2 W	06	32	40	10 NM	02	1017.1	12.2	15.5	4	10	32	< 6	11.5
INGER	AMERICAN	23	39.2 N	124.2 W	00	32	35	5 NM	00	1017.0	14.4	11.1	7	13			
SEALAND MC LEAN	AMERICAN	24	39.4 N	125.9 W	12	33	35	10 NM	00	1014.0	12.3	11.2	3	8	33	6	8
ARCO JUNEAU	AMERICAN	26	33.7 N	120.5 W	12	33	M 35	10 NM	00	1014.0	13.2	12.0	4	5	33	6	8
SEALAND TRADE	AMERICAN	26	36.3 N	122.2 W	12	36	35	10 NM	02	1020.6	12.7	10.7	5	8			
ARCO ANCHORAGE	AMERICAN	28	34.6 N	121.2 W	00	06	M 35	2 NM	10	1018.2	12.2	10.0	4	8	32	< 6	10
SEALAND TRADE	AMERICAN	28	35.6 N	121.6 W	18	32	35	2 NM	02	1017.1	11.7	13.4	7	6.5			
ARCO PRUDHOE BAY	AMERICAN	28	38.2 N	123.5 W	12	34	M 35	2 NM	02	1020.0	16.0	12.5	5	8	35	< 6	14.5
MILLER FREEMAN	AMERICAN	29	56.0 N	173.0 W	12	09	M 36	2 NM	00	993.5	7.2	7.4	5	13			
SPRUCE	JAPANESE	29	48.1 N	174.5 W	00	20	M 35	.25 NM	80	1003.5	11.2	10.0	7	13	02	7	13
SEALAND TRADE	AMERICAN	30	39.0 N	124.9 W	18	33	35	10 NM	02	1019.9	14.2	8.3	7	8			

+ Direction for sea waves same as wind direction
X Direction or period of waves indeterminate
M Measured wind

NOTE: The observations are selected from those with winds ≥ 35 kn or waves ≥ 25 ft from May through August (≥ 41 kn or ≥ 33 ft, September through April). In cases where a ship reported more than one observation a day with such values, the one with the highest windspeed was selected.

Table 11

U.S. Cooperative Ship Weather Reports

May and June 1979

This listing includes only those ships recruited in the U.S. Cooperative Ship Program whose Ship's Weather Observations (NOAA Form 72-1) were mailed to the National Climatic Center and/or the coded weather observations were transmitted to the appropriate radio station.

SHIP NAME	VIA RADIO	VIA MAIL
OGDEN THAMES	34	99
ADABELLE LYKES	4	28
AFRICAN COMET	7	29
AFRICAN SUN	2	
ALASKA STANDARD	20	29
ALBERT MAERSK	23	57
ALLISON LYKES	7	
ALSTER EXPRESS	51	99
AMERICA SUN	31	114
AMERICAN APOLLO	17	136
AMERICAN ARROW	5	
AMERICAN CHARGER	20	108
AMERICAN EXPLORER	2	
AMERICAN LEADER	35	87
AMERICAN LIBERTY	23	143
AMERICAN RELIANCE	16	49
AMOCO MILFORD HAVEN	23	39
ANCO STANE	85	
ANNA MAERSK	23	69
ARCO ANCHORAGE	5	148
ARCO JUNEAU	7	97
ARCTIC TOKYO	20	150
ARTHUR MAERSK	28	79
ASIA BRAVERY	19	101
ASIA HUNTER	2	
ASIAN ASSURANCE		46
AUSTRAL ENSIGN	61	89
AUSTRAL MOON	73	142
AVILA	26	65
BALD BUTTE		81
BARRANCA	22	62
BAYAMON	25	62
BELLADONA VENTURE	13	
BIBB WMEC 31	18	
BOHEME	12	66
BREWSTER	43	108
BUNGA SRIPAGI	49	
C.W. KITTO		107
CAMPBELL WMEC 32	25	57
CARMEN A	7	
CHALLENGER		149
CHARLES PIGOTT	15	88
CHAUVENET T AGS 29		79
CHEROKEE WMEC 165	11	99
CHEVRON ARIZONA	48	69
CHEVRON EDINBURGH		112
CHEVRON LONDON		121
CHEVRON NORTH AMERICA		172
CHEVRON SOUTH AMERICA	1	120
CHUEN ON	5	
COLORADO	53	100
COLUMBUS AUSTRALIA	34	101
COLUMBUS WELLINGTON	26	109
CORAL ACE	17	
COSMOS DIENAH	33	55
CRESSIDA	26	99
DAIOH MARU	3	93
DAVID D. IRWIN		29
DAVIDSON	3	
DEL ORO	13	46
DELAWARE II	61	79
DELTA ARGENTINA	20	55
DELTA MEXICO	15	28
DELTA URUGUAY	5	33
DOCTOR LYKES	41	109
DORIC	24	89
DURABLE CG	1	
EAGLE CHARGER	3	
EASTERN MUSE	101	
EASTERN VENTURE		45
EIDANGER	2	
EL PASO SOUTHERN	17	
ERNA OLDENDORFF	10	
ESSO CHITTAGONG	25	
ESSO PROVIDENCE	90	110
EVERDAWN	2	
EXPORT AIDE	6	
EXPORT BUYER	11	
EXPORT COURIER	22	46
EXXON BALTIMORE	2	49
EXXON FLORENCE	18	42
EXXON JAMESTOWN	34	54
EXXON PHILADELPHIA	42	56
FAIRSEA	15	28
FESTIVALE	9	30
FRANCIS SINCERE NO 6	31	19
GALLEON CORAL	4	
GEMINI	28	113
GENISTA	21	37
GIBRALTAR MARU	10	20
GLOMAR CHALLENGER	56	194
GOLDEN EXPLORER	7	
GOLDEN ORCHID	4	
GRAND CARRIER	9	5
GREAT REPUBLIC	45	86
GREEN ISLAND	6	54
GREEN WAVE	3	
GULF BEAR	2	2
GULF TRADER	19	107
HARDANGER	4	9
GULF TRADER	19	107
HELIOS	14	12
HIEI MARU	105	79
HOEGH MARLIN	10	101
HOEGH OPAL	9	
HOTAKA MARU	75	30
IBERVILLE	1	
INGHAM WMEC 35	4	
IRONWOOD WLB 297	32	
J LOUIS	44	84
JAG DARSHAN	9	
JAMES	18	
JAPAN ACE	99	51
JARVIS WMEC 725	87	215
JOHN A. MCCONE		139
JOHN TYLER	15	64
JUTHLANDIA	10	107
KEYSTONER	109	67
KOPAA	80	103
KOREAN JUPITER	4	19
L.W. FUNKHOUSER		167
LAKE PALOURDE	10	133
LASH ITALIA	2	52
LEO	19	31

SHIP NAME	VIA RADIO	VIA MAIL
ACADIA FOREST	47	
ADM WM M CALLAGHAN	24	100
AFRICAN DAWN		25
AGAPI	1	
ALASKAN	11	46
ALERT	16	
ALLTRANS EXPRESS	22	54
ALVA MAERSK	17	69
AMERICAN ACCORD	35	119
AMERICAN AQUARIUS	31	129
AMERICAN ASTRONAUT	42	118
AMERICAN CHIEFTAIN	27	123
AMERICAN INDEPENDENCE	2	
AMERICAN LEGACY	31	91
AMERICAN LYNX	10	126
AMERICAN TRADER	46	249
AMOCO TEHRAN	1	
ANCO TEMPLAR	37	
ANTE TOPIC	11	127
ARCO ENTERPRISE	15	17
ARCO PRESTIGE		31
ARECIBO	67	108
ARTHUR MIDDLETON	6	43
ASIA FLAMINGO	9	
ASIA INDUSTRY	6	
ATLANTIC JAMACIAN	1	
AUSTRAL ENTENTE	25	50
AUSTRAL PATRIOT	11	37
AXEL JOHNSON	13	15
BALTIMORE	1	
BARTLETT AGOR 13	1	
BAYANO	1	25
BELLMAN	52	44
BLUE OCEAN	35	129
BONITA	6	
BRIGHT HOPE	25	2
BUTTONWOOD WLB 306	49	
CALIFORNIA RAINBOW	8	23
CAPRICORN		28
CARNIVALE	19	28
CHALMETTE	74	16
CHARLESTON	7	17
CHAVEZ	56	114
CHESHIRE	2	
CHEVRON BURNABY	22	
CHEVRON FELUY	4	105
CHEVRON LOUISIANA	15	16
CHEVRON OREGON	10	
CHEVRON WASHINGTON	46	116
CITY OF DUNDEE	1	
COLUMBIA	33	68
COLUMBUS LOUISANA	60	105
COMET	18	29
CORANTIJN	3	15
COURAGEOUS WMEC 622		94
CRISTOBAL	17	84
DALLAS WHEC 716	1	
DAVID P REYNOLDS	79	163
DE STEIGUER T-AGOR12	1	
DEL RIO	23	86
DELAWARE SUN	19	59
DELTA BRASIL	24	46
DELTA PANAMA	1	5
DIANA PROSPERITY	25	99
DOLLY TURMAN	35	86
DRAGAMINAS	81	
DYVI KATTEGAT	30	50
EASTERN BRIDE	6	
EASTERN PACIFIC	31	47
EASTERN WISEMAN	27	
EL MEXICANO	2	
ELIZABETH LYKES	13	
ESSO BANGKOK	1	
ESSO KOBE	1	
EVER SPRING	13	102
EVERGREEN WAGO-295	41	49
EXPORT AMBASSADOR	5	
EXPORT CHALLENGER	25	116
EXPORT FREEDOM	16	62
EXXON BANGOR	5	59
EXXON GETTYSBURG	22	24
EXXON LEXINGTON	2	13
EXXON SAN FRANCISCO	32	111
FAIRWEATHER	7	
FLEETBANK	32	
FREDERICK LYKES	10	
GALLEON JADE	9	
GEMINI TRADER	3	
GEORGE M KELLER	5	184
GLACIER BAY	20	123
GOLDEN ARROW	97	54
GOLDEN GATE	27	
GOLDEN RAY	6	29
GRAND FELICITY		6
GREEN AUKLET	30	
GREEN PORT	16	37
GUADALUPE	16	25
GULF FARMER	23	34
GULFQUEEN	1	
HARNGJIN	12	40
GULFQUEEN	1	
HELLESPONT GLORY	4	100
HILCO SPRINTER	3	18
HOEGH MASCOT	27	37
HOHSING ARROW	2	39
HOUSTON	10	81
IDAHO	1	
IONIAN LEADER	4	
ITALY MARU	23	40
J R GREY		128
JALAVANINI	3	
JAMES E O'BRIEN	4	
JAPAN AMBASSADOR	44	16
JEAN LYKES	15	46
JOHN B WATERMAN	9	57
JOSEPH HEWES	58	52
KASHU MARU	67	35
KINGDOM VENTURE	27	
KOREA PHOENIX	2	
KOREAN PRIDE	13	
LABRADOR CLIPPER	2	
LAKE SHASTA		125
LASH PACIFICO	13	44
LESLIE LYKES	41	21

SHIP NAME	VIA RADIO	VIA MAIL
ACONCAGUA	18	
ADRIAN MAERSK	35	103
AFRICAN MERCURY	15	
AGUADILLA	64	105
ALBANY	1	
ALEUTIAN DEVELOPER	25	27
ALMERIA LYKES	31	99
ALVINA	17	
AMERICAN ACE	27	100
AMERICAN ARCHER	69	107
AMERICAN CHALLENGER	2	15
AMERICAN CORSAIR	6	50
AMERICAN LANCER	44	140
AMERICAN LEGEND	28	90
AMERICAN RACER	12	80
AMERICAN WHEAT	1	
AMOCO TRINIDAD	1	
ANDALUSIA	7	
ANTONIA JOHNSON	33	63
ARCO FAIRBANKS	12	192
ARCO PRUDHOE BAY	2	114
ARILD MAERSK	27	68
ASHLEY LYKES	22	52
ASIA HERON	3	
ASIA MORALITY	3	
ATLANTIC PIONEER	17	115
AUSTRAL ENVOY	26	37
AUSTRAL PILOT	6	26
AXEL MAERSK	48	82
BALTIMORE TRADER	5	75
BARMA	11	52
BAYNES	1	
BERGLJOT	28	34
BLUEBIRD	73	42
BORINQUEN	62	130
BRINTON LYKES	15	49
C V LIGHTNING	10	72
CALIFORNIAN	47	81
CARBIDE SEADRIFT	31	78
CEDRELA	32	75
CHANCELLORSVILLE	21	81
CHARLOTTE LYKES	22	80
CHENNAI SADHANAI	24	125
CHESNUT HILL	9	85
CHEVRON CALIFORNIA	30	69
CHEVRON HAWAII	34	76
CHEVRON MISSISSIPPI	70	100
CHEVRON PERNIS	41	189
CHIKUMA	1	
CK APOLLO	6	
COLUMBIA RIVER L/V	271	264
COLUMBUS NEW ZEALAND	16	70
CONALCO	41	
CORNUCOPIA	35	128
COVADONGA	4	72
CRYSTAL REED	8	
DANWOOD ICE	21	33
DAVID PACKARD	1	139
DECISIVE WMEC-629	3	60
DEL SOL	4	12
DELTA AFRICA	6	38
DELTA ECUADOR	35	56
DELTA PARAGUAY	2	5
DISCOVERER OSS	146	174
DON JUAN	31	48
DRUCILLA U	37	
DYVI PACIFIC	40	72
EASTERN FORTUNE	20	
EASTERN SUN		9
EASTERN WORLD	20	
EL PASO ARZEW	2	161
EMPIRE STATE	14	22
ESSO BAYONNE	9	
ESSO PALM BEACH	12	22
EVER SUMMIT	14	84
EXPORT ADVENTURER	4	
EXPORT BANNER	17	57
EXPORT CHAMPION	12	42
EXPORT LEADER	19	65
EXXON BATON ROUGE	26	37
EXXON HOUSTON	39	84
EXXON NEW ORLEANS	12	29
EXXON SEATTLE	5	12
FALSTRIA	51	121
FORT HOSKINS	2	40
FRIENDSHIP	24	81
GALLEON PEARL	10	9
GENE TREFETHEN	85	
GEORGE WALTON	16	48
GLADIOLUS	9	48
GOLDEN DAISY	22	105
GOLDEN GATE BRIDGE	123	86
GOWANBANK	45	
GREAT LAND	44	73
GREEN FOWARD	12	
GREEN SPRINGS	13	21
GUAYAMA	43	136
GULF MERCHANT	3	9
GUTENFELS	7	
HARUNA MARU	101	29
GUTENFELS	7	
HERON	53	67
HILLYER BROWN	27	32
HOEGH MERCHANT	5	56
HONGKONG PHOENIX	5	5
HOWARD W BELL		55
INACHUS STAR	26	87
IRIS ISLAND	28	84
ITAPUCA	6	
J T HIGGINS		66
JALAYAHUNA	15	
JAMES LYKES	18	27
JAPAN AMBROSE	22	23
JEFF DAVIS	10	35
JOHN LYKES	33	87
JOSEPH LYKES	13	65
KATHY	1	
KNORR	41	112
KOREAN COMMANDER	9	37
KRPAN	103	
LAKE ARROWHEAD	13	61
LAKE TAHOE	37	101
LAUREL	56	78
LETITIA LYKES	29	

SHIP NAME	VIA RADIO	VIA MAIL
ACUSHNET WAGO 167		111
AEGEAN SUN	1	
AFRICAN METEOR	12	
AIMEE LYKES	33	
ALBATROSS IV	42	
ALEX STEPHENS	7	30
ALPHA HELIX	8	13
AMERICA MARU	94	52
AMERICAN ALLIANCE	33	102
AMERICAN ARGOSY	34	112
AMERICAN CHAMPION	32	
AMERICAN COURIER	5	29
AMERICAN LARK	39	151
AMERICAN LEGION	28	116
AMERICAN RANGER	26	103
AMOCO CAIRO	1	115
ANCHORAGE	22	57
ANDERS MAERSK	26	77
AQUILA	14	4
ARCO HERITAGE	3	74
ARCO SAG RIVER	2	131
ARNOLD MAERSK	30	61
ASIA BOTAN	2	
ASIA HONESTY	28	93
ASIA ZEBRA	19	
AUSTRAL ENDURANCE	33	5
AUSTRAL LIGHTNING	30	72
AUSTRAL RAINBOW	31	109
B T SAN DIEGO	18	91
BARBER TOBA	13	15
BASSWOOD WLB 388	2	
BEISHU MARU	112	29
BYRNES	71	
BOGASARI DUA	1	13
BRAZOS	16	109
BRUNES	1	
C V STAGHOUND	26	94
CAMELLIA VENTURE		23
CARIBIA	14	
CELESTINO	3	
CHARLES LYKES	50	123
CHASTINE MAERSK	34	62
CHERISH	1	7
CHEVRON ANTWERP	7	217
CHEVRON COLORADO	40	80
CHEVRON KENTUCKY	150	
CHEVRON NAGASAKI		104
CHEVRON PERTH	30	204
CHRISTOPHER LYKES	20	122
CLOVER WLB 392	35	
COLUMBUS AMERICA	45	
COLUMBUS VICTORIA	48	125
CONFIDENCE WMEC 619	5	
CORONADO	8	25
CRESCO	13	85
CUMBERLANDIA	6	
DAUNTLESS CG	1	57
DAVID STARR JORDAN	8	29
DEFIANCE	6	106
DELAWARE GETTY	61	114
DELTA AMERICA	1	
DELTA MAR	29	48
DELTA PERU	6	
DITTE SKOU	3	68
DONA CORAZON II		26
[illegible]	10	
EAGLE	64	
EASTERN JADE	9	
EASTERN TREASURE	26	82
EDGAR M QUEENY	59	70
EL PASO SONATRACH		93
ENNA G	4	99
ESSO CASTELLON	19	
ESSO PHILADELPHIA	1	
EVER VALUE	4	10
EXPORT AGENT	4	
EXPORT BUILDER	11	57
EXPORT COMMERCE	5	
EXPORT PATRIOT	10	62
EXXON BOSTON	54	84
EXXON HUNTINGTON	22	56
EXXON NEWARK	23	51
EXXON WASHINGTON	9	25
FEDTRADE	21	32
FRANCE MARU	32	30
FROSTFJORD	2	
GARDENIA	4	45
GENEVIEVE LYKES	30	71
GEORGIANA	25	27
GLOBAL FRONTIER	23	
GOLDEN DOLPHIN		37
GOLDEN MISTRAL	56	88
GRACE	12	
GREAT OCEAN	14	88
GREEN HARBOUR	35	128
GREEN VALLEY	16	33
GULF BANKER	8	
GULF SHIPPER	1	
HAMILTON WMEC 715	14	35
HAWAIIAN CITIZEN	56	102
HAMILTON WMEC 715	14	35
HESS VOYAGER	68	107
HOEGH MALLARD	27	32
HOEGH MERIT	9	35
HONSHU GLORIA	46	161
HOWELL LYKES	29	
INGER	11	153
IRIS QUEEN	106	
J E GOSLINE	56	95
JACKSONVILLE	6	88
JAMAICA MARU	32	26
JANEGA	5	
JAPAN CADBO	8	82
JELA TOPIC	47	
JOHN PENN	10	
JUPITER	53	
KEIYO	17	77
KOFUKU MARU		122
KOREAN FIR	8	22
KUROBE MARU	23	15
LAKE BERRYESSA	26	54
LASH ATLANTICO	7	
LAURIE U	1	
LEXA MAERSK	65	

TOTAL WEATHER REPORTS RECEIVED FROM US COOPERATIVE OBSERVING SHIPS MAY AND JUNE 1979

SHIP NAME	VIA RADIO	VIA MAIL
LING YUNG	39	40
LOIDA	1	
LOUISE	46	114
LUTZ SCHROEDER	5	
MALLORY LYKES	21	101
MAMMOTH PINE	3	8
MANUKAI	72	129
MAR DE CORTEZ	11	130
MARDI GRAS	21	52
MARIAS TAO-57		30
MARJORIE LYKES	15	75
MAUI	71	136
MEADOWBROOK	2	29
MERCY	8	
MILLER FREEMAN	50	91
MING SUMMER	11	
MOBIL LUBE		17
MOBILFUEL	8	58
MONMOUTH		71
MOON RIVER	1	78
MORMACDRACO	23	69
MORMACSEA	8	89
MORMACVEGA	15	28
MOZART FESTIVAL	31	
NAGARA	1	25
NEPTUNE RUBY	66	
NOPAL BRANCO	10	44
NORDIC PRINCE	17	11
NOVIA	28	
OCEANIC	73	171
OGDEN JORDAN	6	
OLEANDER	100	108
ORCO TRADER	39	64
ORIENTAL EXECUTIVE	20	88
ORIENTAL LEADER	9	67
OTTO N. MILLER	1	176
OVERSEAS HARRIET	6	
OVERSEAS NEW YORK	57	108
PACDUCHESS	4	
PACIFIC ACE	10	48
PACIFIC EXPRESS	30	15
PACIFIC TRADER		27
PACLADY	2	34
PACPRINCE	5	
PAN ASIA	8	9
PAYSANDU	29	
PERSIAN REEFER	4	58
PIONEER COMMANDER	37	89
PIONEER MOON	42	77
POLARSTERN	1	
PRESIDENT ADAMS	29	30
PRESIDENT HARRISON	46	122
PRESIDENT KENNEDY	47	117
PRESIDENT PIERCE	60	137
PRESIDENT TRUMAN	27	80
PROGRESSUS	6	
PVT JOHN R TOWLE	9	53
QUIXADA	16	
RESEARCHER	31	176
RIO MACAREO	1	
ROBERT TOOMBS	23	109
ROYAL VIKING SKY	16	
SAM HOUSTON	2	
SAMUEL S	9	
SANKOSTAR	8	
SANTA CLARA	6	23
SANTA MERCEDES	19	25
SEA FAN	9	16
SEALAND EXCHANGE	48	130
SEALAND MARKET	43	94
SEALAND RESOURCE	45	72
SEALIFT CARIBBEAN	1	
SEATRAIN INDEPENDENCE	34	115
SEATRAIN YORKTOWN	48	173
SENTINEL	7	67
SHENANDOAH	2	
SHUNWIND	34	77
SHENANDOAH	2	
SINCLAIR TEXAS	34	101
SNOWLAND	24	69
SOUTH LIGHT	1	
SPERO	7	
STAR DIEPPE	26	99
STEADFAST WMEC 623	1	
STONEWALL JACKSON	17	46
SUCCESSFUL VENTURE	21	26
SUNWARD	55	141
SWEETBRIER WLB 405	50	
TAI TUNG	8	16
TARPON		39
TENNESSEE	14	21
TEXACO MISSISSIPPI	2	16
TEXAS SUN		73
THOMAS JEFFERSON	6	
THOMPSON PASS	21	41
TOKYO RAINBOW	11	16
TOWNSEND CROMWELL	82	163
TRANSCHAMPLAIN	62	127
TREIN MAERSK	6	24
UNIMAK WTR-379	15	29
UNIVERSE	25	47
VALLEY FORGE	1	37
VAN UNION	1	
VENTUROUS WPC 625	11	
VIOLET	48	29
WESER EXPRESS	23	99
WILLI REITH	100	
WORLD SUPREME	7	28
YOUNG SEAGULL	21	90
ZIM GENOVA	21	68
ZIM TOKYO	37	97
A8MJ	6	29
CPHU		32
DZJF		10
D5DH	12	37
D7BP	3	9
ELFY		64
GWHQ	30	56
HOML	19	58
H3AG	40	92
JBXC	3	29
JJTK	29	27
KCAF		5
KIIU		8
KNSP	1	9
KYVW		26
LHQQ	3	14
NHWF		89
NTRI	2	42
SGLV		27
S6ZD		8
WETB		7
WSNB	28	89
WSDX		12
3EBA	12	51
3EDU	16	25
5LUB	40	121
5ZMS		40
6ZMT	2	11
9VVD	43	146

SHIP NAME	VIA RADIO	VIA MAIL
LIONS GATE BRIDGE	63	37
LONG BEACH	3	
LOUISE LYKES	40	49
LYNCH T-AGOR 7	17	91
MALLOW WLB 396	51	69
MANHATTAN DUKE	26	
MANULANI	65	127
MARCONA CONVEYOR	50	131
MARGARET LYKES	9	82
MARINE CHEMICAL TRANSP	31	90
MASON LYKES	22	44
MAUMEE	33	93
MEDITERRANEAN CARRIER	67	132
METEOR T-AKR 9	30	36
MINERVA	1	
MING YOUNG	15	28
MOBIL POWER	18	45
MOBILGAS	2	16
MONTICELLO VICTORY	18	18
MORANT	59	
MORMACLYNX	20	51
MORMACSKY	14	80
MORMACWAVE	5	51
MT MITCHELL	51	113
NANCY LYKES	25	29
NEW ENGLAND TRAPPER		16
NOPAL LANE	12	
NORSE PILOT	41	32
OCEAN DUKE	13	
OCEANIC ERIN	7	
OGDEN SENEGAL		44
OLGA TOPIC	17	28
ORE JUPITER	10	
ORIENTAL EXPRESS	1	
ORIENTAL QUEEN	10	
OVERSEAS ALEUTIAN	28	71
OVERSEAS JOYCE	4	69
OVERSEAS VALDEZ	8	74
PACDUKE	1	7
PACIFIC ARROW	114	85
PACIFIC GLORY	38	
PACIFIC VENTURE	21	100
PACMAJESTY	11	10
PACPRINCESS	16	
PAN PACIFIC	11	36
PEIRCE	26	
PHILADELPHIA	48	91
PIONEER CONTENDER	11	23
PLANETREE WLB 307	17	
PORTLAND	63	95
PRESIDENT CLEVELAND	9	38
PRESIDENT JACKSON	30	30
PRESIDENT MADISON	45	137
PRESIDENT POLK	59	142
PRESIDENT VAN BUREN	48	111
PROSPERITY	11	
PVT LEONARD C BROSTROM	10	5
RAINIER	7	
RESOLUTE WPC 620	16	20
RIO OLIVIA	17	6
ROBERTSBANK	60	129
RUTH LYKES	10	
SAM RATULANGIE	21	46
SAN FRANCISCO	22	83
SANKOSUN	8	
SANTA FE	12	
SANTO AMARO	33	
SEALAND COMMERCE	59	147
SEALAND FINANCE	46	106
SEALAND MCLEAN	27	93
SEALAND TRADE	45	116
SEALIFT PACIFIC	16	29
SEATRAIN LEXINGTON	52	163
SEAWAY	52	186
SEPTA	43	122
SHERMAN WMEC 720	7	38
SILVERLINE		28
SHERMAN WMEC 720	7	38
SKYWARD	42	47
SOCONY VACUUM	28	76
SOUTHERN OCEAN	1	
SPRINGBANK	1	
STAR DOVER	33	48
STELLA LYKES	16	
STORIS WAGB 38	17	
SUGAR ISLANDER		17
SURVEYOR	52	74
T F L INDEPENDENCE	24	86
TAMAROA WMEC-166	6	46
TESSO		10
TERRIER	19	43
TEXACO MONTANA		14
TEXAS TRADER	19	41
THOMAS LYNCH	25	
TILLIE LYKES	25	60
TOLUCA	8	
TOYOTA MARU 10	109	73
TRANSCOLORADO	8	69
TRIUMPH	32	30
UNION CONCORD	31	
UNIVERSE IRELAND	1	
VAN CONQUEROR	29	125
VAN WARRIOR	29	92
VERRAZANO BRIDGE	31	31
WALTER RICE	14	123
WESTERN SUN		27
WILMINGTON GETTY	30	50
YAMASHIN MARU	98	103
YUKON T-AO 152	2	29
ZIM HONGKONG	10	55
ZOELLA LYKES	12	
A8WB	4	51
DGRL	7	25
D5AO	4	33
D5OH	35	185
D7EG		10
ELJN	28	31
HOAW		6
HOMQ	27	17
H3PY	6	59
JEZL		42
JKIQ		10
KCIF		63
KLRL		2
KPKL	11	23
K5CX		1
LHUK	46	108
NMOS	19	20
OSFS		1
S6PY	17	23
TCCH	15	23
WPJK	9	28
WXBE		20
ZCKV	61	120
3EBM	8	19
3EMC	31	113
5MEI		43
6CZJ		71
6ZXO	29	46

SHIP NAME	VIA RADIO	VIA MAIL
LIPSCOMB LYKES	48	82
LONTUE	24	46
LUIGI GRIMALDI	8	
MAGDALENA	32	
MALMROS MONSOON	2	25
MANISTEE	23	
MANULEI	67	99
MARCONA EXPORTER	29	181
MARIA TOPIC	9	132
MARITIME ACE	10	
MATHIESON	3	
MAYAGUEZ	21	113
MELVIN H. BAKER	84	
MIDAS RHEIN	4	35
MING AUTUMN	30	40
MOBIL AERO		38
MOBILE	8	6
MOBILOIL	3	6
MONTIGNY	14	
MORMACALTAIR	38	99
MORMACRIGEL	6	78
MORMACSTAR	26	79
MORNING GLORY		59
MUNRO WMEC 724	41	
NAVASOTA		14
NEWARK	34	120
NORDHVAL	32	
NORTH STAR III	37	82
OCEAN HAPPINESS	30	
OCEANOGRAPHER	161	191
OGDEN WILLAMETTE	1	
ORANGE	75	
ORE METEOR	1	
ORIENTAL FANTASIA	1	
ORIENTAL SOVEREIGN	37	
OVERSEAS ARCTIC	1	17
OVERSEAS JUNEAU	37	126
PACBARON	7	
PACEMPEROR	6	
PACIFIC BREEZE	1	
PACIFIC PEACE	5	
PACIFIC WING	15	175
PACMERCHANT	10	
PACQUEEN	1	
PARALLA	13	
PENNSYLVANIA SUN		13
PHILIPPINE RIZAL	15	40
PIONEER CONTRACTOR	26	69
POLAR ALASKA		91
PORTMAR		37
PRESIDENT EISENHOWER	41	127
PRESIDENT JEFFERSON	57	116
PRESIDENT MC KINLEY	38	143
PRESIDENT TAFT	44	56
PRINCE OF TOKYO	12	86
PROVINCIA DE EL ORO	20	
QUEENS WAY BRIDGE	40	37
RED ARROW	3	23
REVERE	4	50
RIO TUXPAN	2	
ROSE	10	56
SAINT LOUIS	4	51
SAMOA	29	57
SAN JUAN	104	174
SANSINENA II	15	94
SANTA MAGDALENA	19	41
SARGODHA	22	41
SEALAND CONSUMER	16	77
SEALAND GALLOWAY	27	97
SEALAND PIONEER	13	91
SEALAND VENTURE	33	136
SEATRAIN BUNKER HILL	30	96
SEATRAIN PRINCETON	67	96
SEAWAY DISPATCH	40	106
SEVEN OCEAN	26	99
SHING ON	18	26
SINCERE NO 3	7	102
SHING ON	18	26
SNOW CRYSTAL	24	62
SOHIO RESOLUTE	1	
SOUTHWARD	32	54
SPRUCE	30	105
STAR HONGKONG	17	36
STOLT CROWN	1	
STREAM HAWSER	1	
SUMBAWA		6
SUSQUEHANNA	10	
T F L LIBERTY	13	85
TAMPA	63	180
TAUBE	36	60
TEXACO FLORIDA	12	16
TEXAS	38	50
TFL DEMOCRACY	28	61
THOMAS NELSON	9	30
TOBIAS MAERSK	13	25
TONAMI MARU	45	28
TOYOTA MARU 14	13	31
TRANSCOLUMBIA		61
TROLL LAKE	20	
UNION PROGRESS	12	67
UNIVERSE KURE	21	148
VAN ENTERPRISE	17	
VANGUARD	28	100
VICENTE GUERRERO	13	21
WASHINGTON RAINBOW		55
WESTWARD VENTURE	42	93
WORLD MEDAL	1	
YOCONA WMEC 168	6	
ZAPATA PATRIOT	8	
ZIM MONTREAL	9	69
30N 71W	1	
BLEL	22	108
DSPX		35
D5ES	23	101
D9PX	20	57
D7XX	12	48
ELPA	11	31
HODD		1
HOQJ		48
H3SY		48
JHJZ		39
JLJL	57	35
KESN	3	8
KMDL		11
KSLJ	28	96
LEVH	10	31
NBIU		26
NIUB		26
OYNB	42	59
WDOB		47
WPQE	5	65
WYS3261		52
ZFCB	40	115
3EBR	4	3
3EXC	19	24
5MME		36
6MJH		3
8JJJ	12	5

SHIP NAME	VIA RADIO	VIA MAIL
LLOYD CUIABA	2	
LORD NIAGARA	1	
LURLINE	108	161
MAINE	27	73
MAMMOTH FIR	31	101
MANUAWILI	94	174
MANZANARES	17	
MARCONA TRANSPORTER	36	89
MARIA U	4	
MARITIME DOMINION	2	
MATSONIA	46	122
MAYO LYKES	21	123
MEDMIA	67	144
MIDGETT WMEC 726	100	170
MING SPRING	27	35
MOBIL ARCTIC	13	43
MOBILE MERIDIAN	40	155
MODOC WMEC-194	22	
MONTIRON	12	
MORMACARGO	11	47
MORMACSAGA	17	41
MORMACTIDE	5	60
MOUNT VERNON VICTORY	8	16
NAESS LEADER	2	
NECHES	16	17
NEWCASTLE CLIPPER	61	
NORDIC LOUISIANA	70	
NORWALK	1	
OCEAN HARMONIA	10	
OGDEN CONGO	39	108
OJI GLORIA	32	31
ORCO MINER	1	
ORIENTAL COMMANDER	18	51
ORIENTAL FINANCIER		11
ORIENTAL STATESMAN	15	32
OVERSEAS CHICAGO	1	
OVERSEAS NATALIE	7	9
PACBARONESS	3	
PACGLORY	4	
PACIFIC ERA	45	37
PACIFIC SAGA	19	
PACKING	4	
PACMONARCH	1	7
PACSTAR	7	
PAUL L FAHRNEY		108
PEREIRA D'ECA	1	
PINE LIGHT	7	
PIONEER CRUSADER	29	74
POLAR SEA	37	38
PORTUGAL MARU	15	27
PRESIDENT FILLMORE	48	127
PRESIDENT JOHNSON	71	162
PRESIDENT MONROE	12	120
PRESIDENT TAYLOR	17	46
PRINCE WILLIAM SOUND	31	102
PURE OIL	16	39
QUINTINA	20	
REGINA CELI	5	
RICHARD	63	111
RUBERT E LEE	6	31
ROSE CITY	2	87
SALVADOR	13	31
SAMOAN REEFER	22	36
SAN MARCOS	61	48
SANTA BARBARA	1	9
SANTA MARIANA	5	
SCHUYLER OTIS BLAND	1	
SEALAND ECONOMY	49	125
SEALAND LEADER	38	112
SEALAND PRODUCER	23	12
SEALIFT ATLANTIC	2	12
SEATRAIN CONCORD	49	92
SEATRAIN TRENTON	63	175
SELANDIA	31	91
SHELDON LYKES	25	
SHIRLEY LYKES	23	
SINCERE NO 5	8	
SHIRLEY LYKES	23	
SNOW STORM	21	159
SOLON TURMAN	31	
SOUTHWIND	1	
STADT BREMEN	38	
STATE OF MAINE	52	101
STOLT LLANDAFF	21	61
STUYVESANT	70	186
SUNNY OCEAN		90
SVENDBORG MAERSK	9	66
T S PETERSEN	1	
TANEY WHEC 37	11	44
TEMA STAR	3	
TEXACO GEORGIA	4	14
TEXAS CLIPPER	28	
THOMAS G THOMPSON	57	
THOMPSON LYKES	21	74
TOHBEI MARU	35	6
TONCI TOPIC	4	112
TOYOTA NO 24	12	1
TRANSONEIDA	54	74
TSUI YUNG	1	
UNITED SEA ANGEL	15	71
USNS MIRFAK	6	33
VAN TRIUMPH	13	87
VELMA LYKES	16	17
VILLANGER	1	
WECOMA	42	16
WHITING	17	
WORLD RUBY	26	36
YOUNG AMERICA	19	114
ZENLIN GLORY	12	
ZIM NEW YORK	29	84
ATJL	7	20
BMOK		4
DVXL		70
D5NO	10	22
D5OH		33
D8OC	5	27
ELXT	12	121
HOOT		161
HPBA	2	12
H3BY		58
JJKL		23
J8CO	18	93
KHLQ	13	54
KNHB		28
KWDL		12
LFEL	13	46
NBSZ		43
NNBN		329
SGLU	14	48
S6ED	28	68
WDZG	1	46
WNJF		4
WZVT		17
O31F		1
3EJE	11	32
3FCW	4	26
5MOS	5	5
6YZA		7
9VPV	30	104

SUMMARY: GRAND TOTAL VIA RADIO 22986 GRAND TOTAL VIA MAIL 52218

Continued from page 408.
damage. The 6,186-ton Canadian icebreaker JOHN A. MACDONALD commenced breaking out of Summers Harbor (70°N, 125°W) on the 6th. First-year ice was ten tenths, 6 to 9 ft thick, with ridges 24 ft thick. She received heavy ice damage and propeller damage on the 28th. Temporary repairs were made at Tuktoyaktuk.

The following casualties occurred in the Indian and South Pacific Oceans. The 14,412-ton PACDUCHESS sustained damage when containers shifted in heavy weather between Melbourne and Adelaide on the 17th and 18th. Barges from the Russian barge carrier JULIUS FUCIK broke loose in Bombay Harbor during heavy weather and contacted the EFFIGYNY. On the 27th the GULF PEARL (1,831 tons) returned to Bombay with water damage to hatches from heavy weather that day. The 15,409-ton Liberian AVILES broke in half, exploded, and sank 400 mi off the southwestern coast of India. The ESSO SCOTIA engaged in rescuing survivors. The weather during the rescue was winds northerly force 7, seas rough 8 to 13 ft, and swells of 25 ft. The Indonesian cargo vessel ASAHAN (8,661 tons) put into Bombay for heavy-weather damage. The 150,000-ton Liberian tanker BRAZILIAN PEACE alleged heavy-weather damage June 12 to 14 on a voyage Kharg Island to Sao Sebastiao. On the 11th the 7,144-ton Greek EVDOKIA was abandoned by most of the crew after developing a leak and listing in heavy weather. Later in the day she struck rocks and broke up and sank near 34°S, 24°E. One crewmember died and five were missing.

Rough Log, North Atlantic Weather

August and September 1979

ROUGH LOG, AUGUST 1979--The chart showing the tracks of low-pressure centers was very busy this month for a summer month. This was especially true over northeastern Canada and over waters between Newfoundland and Iceland. Storms fed into a focal point south of Kap Farvel from the west and southwest. The area bordering the North Sea had a stormy month.

The mean sea-level pressure analysis was near normal. The area south of the zero isoline, which stretched from Cape Chidley to Ireland, was slightly positive. The highest positive area was off the Iberian peninsula with a maximum of 4 mb. The area of highest negative anomaly was minus 5 mb over Foxe Basin.

The Azores High was 1025 mb near 37°N, 30°W, north of the Azores Islands. There were two LOW centers, a normally located one south of Iceland at 1008 mb and a 1004-mb center over Foxe Basin about 500 mi northwest of its usual 1008-mb position over Cape Chidley.

The flow in the upper air was mainly zonal over the ocean between latitudes 40° and 60°N. The long-wave troughs were over the interior of eastern North America and western Europe. There was a short-wave trough that paralleled the North American coast from Newfoundland to Cape Hatteras. The major difference from climatology was a closed LOW, rather than a trough, over Foxe Basin. The primary center of circulation is normally located over the North Pole, but this month it split into several centers.

The last week of the month produced three tropical cyclones, two of which were severe hurricanes--they were David and Frederic. Between the two was tropical storm Elena.

Extratropical Cyclones--The first storm of the month formed near the juncture of the Ohio and Mississippi Rivers on the 1st. It passed over the Great Lakes as a weak LOW on the 2d. On the 4th it was over the Labrador Sea. The storm crossed north of the 5MOU, which was stationary near 51°N, 51°W, with gale winds that shifted from south to northwest between 0000 and 1200. The storm was only 992 mb as it passed south of Iceland on the 5th, but its area of coverage had expanded. At 1200 the UNION PROGRESS felt 66-kn winds southwest of the center. Waves of 15 ft were occurring in both the southeast and southwest quadrants. The MARIE LEONHARDT had 43-kn winds in the southeast quadrant at 1800. On the 6th the storm disappeared as it blended into a LOW to the north.

Monster of the Month--The eastern slopes of the Rocky Mountains produced this storm on the 8th. It moved across the northern United States and produced thundershowers. On the 11th it moved offshore, still producing little except rain showers. It was moving eastward at about 25 kn under zonal flow. At 1200 on the 13th the storm was 1006 mb still as a frontal wave off the Brest peninsula. By 1800 there was an indication of deepening. Ocean Weather Station Romeo had 40-kn winds and 16-ft seas. The HUMACAO (50°N, 16°W) reported 55-kn northwesterly winds and 17-ft seas. At 0000 on the 14th the storm had plunged to 980 mb near Fastnet Rock. Romeo had 20-ft waves.

The storm caught the yachts in the Fastnet race. They had left Cowes on the Isle of Wight on the 11th to race to Fastnet Rock and return to Plymouth (fig. 32). The storm struck as many were rounding Fastnet Rock and sailing toward the Isles of Scilly. The winds blew up to 60 kn with giant seas (fig. 33) reported as high as 60 ft. There were 14 lives and 22 yachts lost. Many others were injured and many yachts damaged though

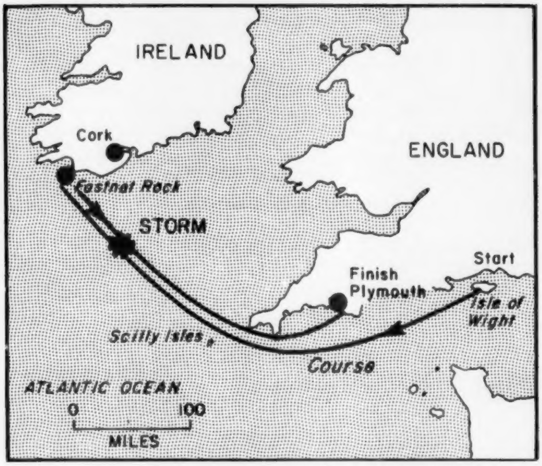


Figure 32. --The course the yachts were to follow.

Figure 33. --The deserted yacht BALLIVANT II is still being battered by heavy seas off the southwest coast of England on the 14th. Wide World Photo.

Figure 34. --The American yacht IMP (left) and the Japanese yacht GEKKO (right) are shown at the start of the race on the 11th. Wide World Photo.

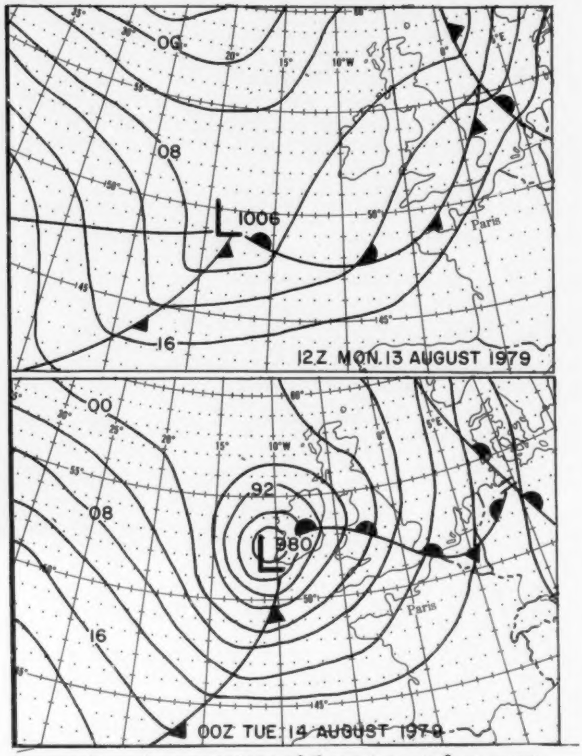


Figure 35. --A comparison of these two surface maps shows the explosive deepening that occurred in 12 hr, from a 1006-mb frontal wave (top) to a 980-mb storm (bottom).

Figure 36. --This is how the storm looked from space at 1535 on the 13th. The storm has already started to intensify.

not lost (fig. 34). There were 306 yachts in the race crewed by 3,000 yachtsmen. Rescue services saved more than 130 people. At 1200 on the 14th the C.S. ALERT north of Cabo Finisterre had 20-ft seas. Several ships had strong gales. The ATAMAN was in the northwesterly flow not far from OWS Charlie with 44-

kn winds and 26-ft swells. Swells of 16 ft extended from OWS Charlie into the Bay of Biscay.

The intensification of the storm was connected with the development of upper air support. At 0000 of the 13th the primary upper air LOW at 700 mb was southwest of Iceland with a quasi-stationary surface LOW. At 0000 on the 14th another LOW, supporting this storm, had developed at 700 mb northwest of Ireland. This allowed rapid strengthening of the surface storm (figs. 35 and 36).

The VOSGES was on the North Sea with 50-kn winds and 39-ft swells at 1800 on the 14th. By the 15th the storm was northeast of the Shetland Islands, bringing its last blows to the North Sea. It continued northward to end over Greenland on the 17th.

This storm came out of the southeastern United States and crossed over water near Delaware Bay on the 13th. Two ships reported gales almost immediately. At 1800 the SEALAND MARKET (41°N, 65°W) found 50-kn winds

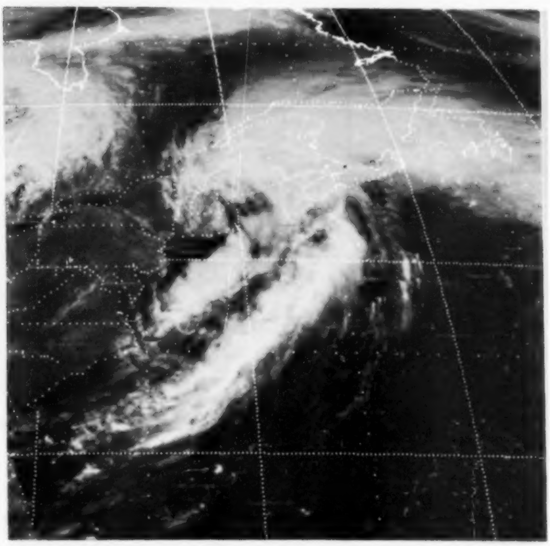


Figure 37.--At 1700 the storm was centered near Cape Cod.

from the south-southwest and 15-ft waves (fig. 37). At 0600 of the 14th the LOW was 986 mb near Sept-Iles. At 1200 a ship east of St. John's had 48-kn southerly winds. On the 15th the weather station at Cartwright measured 40-kn winds. At 1800 the ATAMAN and ATLANTIC PROJECT both near 52°N, 42°W, had winds between 44 and 50 kn. They had 20- to 30-ft seas and 33-ft swells. The storm loitered off the southeast coast of Greenland on the 17th and then disappeared on the 18th.

There was a col area over Baffin Island on the 16th. By the 17th a weak cyclonic circulation could be found on the analysis. Two small LOWs nearby were absorbed into the circulation on the 18th and at 1200 it was 988 mb near 70°N, 70°W. A tight gradient was forming over Baffin Bay. The BAMSA DAN was near 67°N, 55°W, with 44-kn winds out of the south. The

Figure 38.--The LOW was south of Kap York at 1800 on the 19th. Southern Baffin Bay is clear, except for clouds over the Greenland coast.

seas were 21 ft. At 1800 the KUNUNGUAK (71°N, 52°W) in Umanak Fjord had 37-kn winds off the Icecap and down the fjord. At 0000 on the 19th BAMSA DAN was near the same position and reported 44-kn winds with 30-ft seas; at 0600 she reported 52 kn and 30 ft. The KUNUNGUAK now had 44-kn winds in the fjord. At 1800 on the 19th another ship OXZM had 44-kn winds off Sondre Stromfjord (fig. 38).

The LOW was drifting northward and was over Ellesmere Island on the 20th. On the 22d and 23d it looped southward then northward again and disappeared over the Arctic Ocean on the 24th. It's not likely that there were many ships that far north to report.

During the last 10 days or so of the month the circulations over the North Atlantic were relatively weak and diffuse. Early in the period there was a well-defined cyclonic circulation over the Norwegian Sea and a disorganized storm over Newfoundland. On the 27th 37-kn easterly winds were reported at 74.5°N, 82.6°W, in Lancaster Sound by the Canadian LABRADOR. On the same day a waterspout was spotted off West Palm Beach and a funnel cloud was seen over Galveston Bay.

This storm was not a large one, but there were several significant wind reports. The storm formed off Newfoundland late on the 26th. On the 27th the NOVO MESTO was 200 mi south of the center with 37-kn winds and 12-ft seas. Six hours later at 1800 she had 50-kn winds as did the ORTEGA both in the vicinity of 42°N, 42°W. At 0000 on the 29th the storm was only 1005 mb near 45°N, 28°W. The KAPITAN LEDOCHOWSKI was about

200 mi to the northeast with 45-kn northeasterlies.

On the 30th the storm turned northward. It passed almost directly over OWS Lima on the 31st at 1600. By September 1 it was 990 mb south of Iceland, and Icelandic fishing vessels were reporting gales. The storm ended its days over the Norwegian Sea on the 5th.

This storm began at the point of occlusion on a front over Goose Bay on the 31st. The BEN OCEAN LANCER was north of Cape Chidley in the original southeasterly circulation late on the 30th with 42-kn winds. An American ship (KBCG) was a few miles to the east with winds of 37 kn. She was reporting every 3 hr with winds about 40 kn and at 0600 on the 31st had 26-ft seas. The LOW was 986 mb on the first chart of September at 56°N, 57°W. The PELICAN was near Hebron and the KBCG was off the southwest coast of Greenland. Both had 40-kn winds, but from opposite directions. The latter reported 25-ft seas from the southeast. On the 2d the SELFOSS was south of Kap Farvel with 44-kn winds as the LOW reversed its track and turned southeastward. The MANCHESTER CRUSADE found gales with 16-ft waves northwest of the center. The storm finally moved over Iceland into the Norwegian Sea.

Tropical Cyclones--Hurricane David developed on the 26th in the south-central North Atlantic, followed 3 days later by hurricane Frederic. Both storms moved west-northwestward through the northern Caribbean before recurving northward into the United States. The two storms coexisted from August 29 through September 15.

David developed explosively during the last week in August. By the 29th he was moving through the Martinique Passage with 110-kn winds roaring around his 938-mb center. Dominica was hardest hit as 90-kn plus winds, storm tides, and torrential rains devastated the island, leaving 23 people dead and some 60,000 homeless. On Martinique, Fort St. Louis reported 89-kn winds, while 15-ft seas battered Fort de France. By the 30th David's pressure had dropped to 924 mb with winds estimated at 130 kn. Puerto Rico received the backlash of winds, rain, and storm tides as David passed 70 to 80 mi to the south.

On the 31st, 130-kn winds roared around a 929-mb pressure center. Later in the day David took his fury northwestward across the Dominican Republic coast just west of Santo Domingo. Winds in the capital city climbed above 90 kn before the wind equipment blew down. Central pressure was 926 mb as David made landfall, but he was on a collision course with the rugged mountains of Hispaniola. His Friday night trek brought tragedy and destruction to the island.

While the mountains of the island weakened the storm, they were also responsible for torrential rains, flash floods, and locally accelerated windspeeds. The great killer was floods. They isolated communities, swept villages away, and were mainly responsible for more than 1,000 deaths that have been estimated so far. The port of Santo Domingo was closed for several days to permit soundings in the channels. At the Sea-Land terminal in Rio Haina a rail-mounted container crane collapsed. Most roads were heavily damaged as were the cities of Jarabocoa, San Cristobal, and Bani. In the mountain village of Padre las Casas several hundred people were killed when a church and school they were using as a haven was swept away by a rampaging river. Crop damage was severe and widespread. Almost 70 percent of the crops were destroyed with damage estimated at $350 million.

Over Labor Day weekend Frederic was spreading heavy rains and strong gusty winds in the Leeward and Virgin Islands, a little north of David's stomping grounds. St. Martin, close to the center, experienced a 58-kn gust on the 3d, while 45-kn wind gusts buffeted Antigua and St. Thomas. St. Croix had a 30-hr rainfall amount of 24 in.

On the morning of September 1 a weakened, somewhat disorganized David showed his eye along the north coast of Haiti. His maximum winds were barely hurricane force. He remained in this state as he crossed the Windward Passage and the eastern tip of Cuba that afternoon. Once over more open waters, David began to reintensify as he headed northwestward. By the 2d 80 kn winds roared around his 980-mb center, which was skirting the western Bahamas. During the afternoon Andros Island reported 60- to 70-kn winds shortly before the eye appeared. Up to 8 in of rainfall was reported in the Bahamas. The GEN SWIERCZEWSKI encountered 50-kn winds as she sailed through the Straits of Florida.

David's winds climbed to 90 kn as he approached southern Florida early on the 3d (Labor Day). A

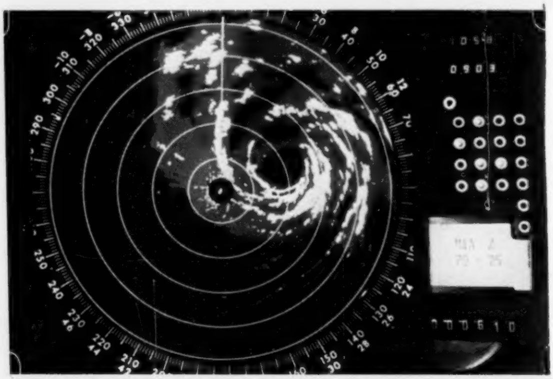


Figure 39.--Miami radar on 125-mi range picks up David at 1058 EST on the 3d.

Figure 40.--Daytona Beach radar catches David's eye south of Melbourne, on the 125-mi range, at 2140 EST on the 3d.

slight northward shift brought David's center about 50 mi east of Miami, where the beaches were buffeted by gale-force winds (fig. 39). Wind gusts of 60 to 70 kn were reported along Florida's east coast as David moved northward. This was accompanied by heavy surf and 2 to 5 in of rain. By the evening David's center was on the beach just south of Melbourne. He remained close enough to water to maintain hurricane strength (fig. 40). West Palm Beach reported 50-kn winds with gusts to 65 kn before the power failed; gusts were estimated to have reached 74 kn (fig. 41).

Figure 41.--David tries to force a sailboat under the bridge connecting West Palm Beach with Palm Beach, Fla. Wide World Photo.

After a short journey over open water on Tuesday (the 4th), David, sporting 80-kn winds, roared across St. Catherine Sound to finally come ashore just south of Savannah Beach, Ga. (fig. 42). Savannah recorded 50-kn winds with gusts to 59 kn and a low pressure of 970 mb. Tides were generally 3 ft above normal. Two French students were drowned in the heavy surf off Jekyll Island. To the north gusts along the coast ranged from 50 to 60 kn. Charleston, S.C., reported 49-kn gusts. Tides ran 2 to 5 ft above normal. Several tornadoes were reported between Charleston and Myrtle Beach. Rainfall was heavy in some areas. Savannah received 6 to 7 in, and there were reports of 9 to 10 in of rain in interior South Carolina. Elsewhere, amounts of 2 to 5 in were common. Flooding was light to moderate. However, in North Carolina major flooding was reported on the Lumber River.

On his journey northward as a tropical storm, David continued to spread squalls, with heavy rains and gusty winds, and some tornadoes east and northeast of his center. He made his way through the Carolinas on the 5th. Raleigh and Greensboro, N.C., reported gusts to 31 kn. To the east Elizabeth City was drenched by 8.52 in of rain. Along the coast there was only some minor flooding and beach erosion. By Wednesday night the tropical storm moved through Virginia, Maryland, and into central Pennsylvania. Tornadoes touched down in Maryland, southern and northern Virginia, Pennsylvania, Delaware, and New Jersey. Rainfall amounts ranged up to 8 in, while winds gusted from 30 to 40 kn. Wilmington, Del., recorded a 46-kn gust, while winds at Richmond gusted to 39 kn. Wind and rain were responsible for widespread power outages all along the eastern seaboard. In the New York metropolitan area 2.5 million people were without electricity.

That same day (September 5) the Dominican Republic was bracing itself for a second weather battle in less than 1 week. Frederic had weakened to a tropical storm the day before as he made his way along the northern shore of Puerto Rico, dumping heavy rain and whipping up gales. In the Dominican Republic heavy rains hampered relief operations that had been going on since David. Following David's path Frederic arrived off eastern Cuba on the 7th, a weak depression.

While Frederic struggled across Hispaniola, David finally turned northeastward upon crossing the New York line near Binghampton. As David accelerated through New England, he began to turn extratropical. By late on the 7th he was through New Brunswick, Newfoundland, and out into the open North Atlantic.

At this time Frederic, still a depression, was malingering along the south coast of Cuba. He finally got

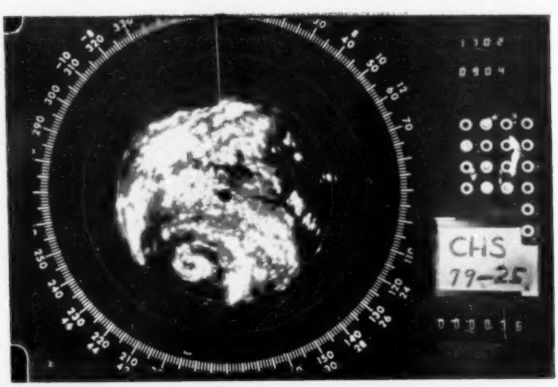


Figure 42.--David approaches Charleston, S.C., at 1702 EST on the 4th (250-mi range).

Figure 43.--Vessel driven aground at Gulf Beach, Fla. Photo by National Hurricane Center.

Figure 44.--Marine damage at Bayou La Batre, Ala. Photograph by National Hurricane Center.

it together on the 9th when he regained tropical-storm strength. The following day Fred turned northwestward, crossed western Cuba, and continued to strengthen as he headed for the U.S. Gulf Coast. By late on the 11th his pressure had fallen to 958 mb, winds had climbed to 105 kn, and gales extended 150 mi north of his center, which was located some 375 mi southeast

Figure 45.--Sounds of silence greet a Mississippi National Guardsman as he passes some of Frederic's plastic victims in downtown Pascagoula. Wide World Photo.

of New Orleans. The next morning, Wednesday the 12th, Frederic was even healthier; 115-kn winds roared around a 945-mb center. Coastal residents from Grand Isle, La., to Panama City, Fla., boarded up homes and businesses. Wednesday evening all hell broke loose from Pascagoula to Pensacola (figs. 43, 44, and 45). Enormous tides, 8 to 12 ft above normal, ran over and sometimes through the barrier islands and up onto the coast and into Mobile Bay. Five- to twelve-foot storm tides flooded Mobile Bay. Winds whipped rain and sea into a frothy blanket along the coast. At Dauphin Island Bridge 125-kn gusts, under a 943-mb pressure, ripped across Grants Pass. At the sea laboratory on the island, gusts reached 103 kn before the equipment blew down. Gusts at Pascagoula reached 110 kn. On top of these winds and tides, fell 7 to 9 in of rain with a few tornadoes. Most of this devastation took place in the dark.

The port of Mobile, normally busy with freighters and tankers, was paralyzed. Power was off. The tanker NORDIC TEXAS, which was in layup at the Alabama Drydock Company, was torn from its moorings and was sunk at the stern on the east bank of Mobile Bay. Shrimp boat manufacturers at Bayou La Batre and Coden were seriously affected. The Ingall's shipyard in Pascagoula sustained extensive damage and was closed for several days.

Frederic marched inland on a northward path and weakened (fig. 46). Gales were accompanied by 2 to

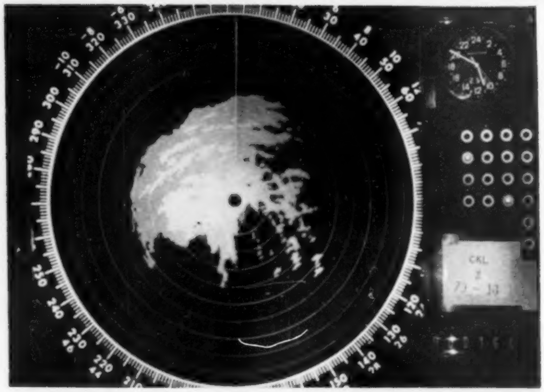


Figure 46.--Centerville, Ala., radar picks up Frederic on 250-mi range at 1050 EST on the 13th.

6 in of rain over northern Mississippi, Alabama, and Tennessee. Frederic was a depression by the time he reached Tennessee late on the 13th. During the night he completed an extratropical transformation. He moved up the west side of the Appalachians, through the Tennessee and Ohio Valleys, and into Pennsylvania and New York. The storm dumped 2 to 5 in of rain. Winds were still strong. Latrobe, Pa., recorded a wind gust of 40 kn, while Bridgeport, Conn., was whipped by 43-kn gusts. Buffalo was doused by nearly 4 in of rain as the remnants moved across New York and northern New England late on Friday the 14th.

Frederic's damage has been estimated at more than $1.8 billion in Alabama and Mississippi; $1.25 billion in Alabama alone. Florida's damage estimate has not yet been released. The death toll in Frederic is eight. Preliminary damage for David has been estimated at nearly $2 billion, with most of that in the Dominican Republic, where the death toll is estimated at about 1,000. In the United States, David was responsible for 16 deaths, while Puerto Rico suffered 9.

Shortly before Frederic was spotted on the 29th a tropical depression formed in the central Gulf of Mexico. Located about 500 mi east of Brownsville, the system was moving westward at about 10 kn. Late the following afternoon Elena was christened, about 190 mi southeast of Galveston. Moving west-northwestward, Elena remained a minimal tropical storm. She slowed upon nearing the coast, and winds of gale force were occurring only in squalls. Tracking slowly and erratically northwestward, Elena approached the coast about 75 mi west of Galveston early on the 1st. She quickly dropped to depression strength. Elena was responsible for heavy rains and thundershowers throughout southeastern Texas. Rainfall amounts of 2 to 5 in were reported.

Casualties--The Turkish coaster TOROSLAR 1 and the PETUNIA collided in fog on the Black Sea on the 5th. The 433-ton PANDA STAR was stranded in fog on the 8th on a sandy beach of north Portugal. The 499-ton MERCURIUS and the 110-ton XMAS ROSE collided in fog outside of Aberdeen harbor on the 12th. The XMAS ROSE sank, but all the crew was picked up by the MERCURIUS and landed at Aberdeen. The 426-ton ROMARK grounded on the river Tweed on the 17th in thick fog. The 31-ft yacht SEA CHANGE sank in a collision in fog with the barge EXXON NEW YORK in Rhode Island Sound. One man from the yacht was missing, and three were rescued by the tug EXXON OCEAN STATE. The 953-ton CARGO-LINER II arrived in southern France with heavy weather damage that occurred from the 16th to the 19th. The 8,658-ton ferry WINSTON CHURCHILL ran aground outside Gothenburg harbor on the 26th in rough weather. All passengers were rescued. There were over 100 vehicles aboard. No serious injuries were reported, and the ferry was refloated. The 18,907-ton Venezuelan INDEPENDENCIA II claimed heavy weather damage on the 28th on arrival at Milford Haven. The 2,123-ton KAPTAN CELAL with a cargo of coal listed and sank in a storm off the Turkish Black Sea coast near the entrance to Bosporus on the 30th. All the crew was picked up by the Russian SUKHUMI.

Other Weather Casualties--The 133,679-ton tanker I.D. SINCLAIR, anchored 11 mi off the South African east coast, was swamped by a mountainous wave on the 9th. One sailor was washed overboard, and four were injured. The tanker suffered no serious damage. Huge swell waves had been occurring. The 10,369-ton SOKAI MARU was 31 mi east of Cape Recife when 11 freight containers were washed overboard in the heavy seas.

ROUGH LOG, SEPTEMBER 1979--The storm tracks this month between the Canadian Maritime Provinces and the Norwegian Sea closely followed the climatological mean for that area. Storms from the U.S. East Coast did not materialize as climatology indicates. The storms that crossed Canada and thence into Baffin Bay formed farther north and west than usual.

If one compared this month's mean sea-level pressure pattern to the climatic normal without any isobars labeled, they would be very similar. With the addition of specific pressures, the differences show up especially north of 40°N. The primary Icelandic Low center is shifted from midway between Kap Farvel and Iceland to west of Nordkapp, Norway. There were five subcenters from Hudson Strait to Nordkapp ranging from 1001 mb to 1005 mb. The Azores High was shifted about 800 mi northeastward to near 40°N, 20°W, and was 2 mb higher at 1023 mb. There was an anomalous 1008-mb LOW over the Yucatan Peninsula.

The largest anomaly south of latitude 40°N was minus 3 over the Gulf of Mexico and probably a reflection of tropical cyclones. A plus 7-mb anomaly was centered near Brest, France. On the negative side, there were two main centers, a 4 mb near Cape Wolstenholme and a 7 mb over Lapland.

The height of the 700-mb surface, centered over latitude 30°N, was normal with climatology. The large difference with climatology were the LOWs. Usually there is one centered near the North Pole. This month there was one near Cape Dorset and another near Jan Mayen Island. This resulted in a sharper trough over eastern North America and stronger zonal flow across the water.

Three tropical depressions formed in September, and two became hurricanes Gloria and Henri. David and Frederic formed in August, but they struck the United States in September.

Extratropical Cyclones--The headline makers this

month were the two hurricanes that struck the West Indies and the United States. Both originated in August, but they will probably be remembered as September storms as that was when their major devastation occurred. The first half of the month the Azores High was weak and generally broken up into multiple cells. This allowed LOWs to penetrate farther south. The last part of the month the High intensified and storms were generally diverted farther north.

The first storm of significance was off Hamilton Inlet on the 1st. The SEDCO 709 near 63°N, 59°W, reported 40-kn easterly winds with 25-ft waves. The NORTHERNSHELL was closer to the coast of Labrador with 40-kn northwesterly winds. On the 2d the SELFOSS at 56°N, 45°W, was north of the storm with 44-kn winds. The storm had been moving southeastward and at 1200 on the 3d was near 51°N, 40°W. Several ships reported gales and waves to 16 ft. On the 4th the storm turned northeastward. The SEA-LAND ECONOMY on the southern edge of the storm radioed 51-kn winds. The DISCOVERY was east of the front and west of Lands End on the 5th with 45-kn winds and 14-ft waves.

The 986-mb storm was traveling northward over Iceland on the 6th (fig. 47). A station on the northwest peninsula measured 50-kn winds from the north-northeast at both 0000 and 1200 synoptic times. The WESTWIND was reporting off the northeastern coast of Greenland. The storm disappeared over the Greenland Sea on the 10th.

Extratropical David--By 1200 on the 7th David was over the Gulf of St. Lawrence and a 980-mb extratropical storm. The FREDERICK CARTER was in Cabot Strait with 55-kn winds. On the 8th the CAPE ROGER was caught off Belle Isle with 40-kn winds and 20-ft seas. At 1200 on the 8th the 988-mb storm was south of Kap Farvel and the C. P. DISCOVERER was south of the center with 26-ft swells. The ECKERT OLDENDORFF found 40-kn winds and 20-ft waves on the 9th. At 1200 it was over Iceland bringing gales to the area. The storm continued to kick up gales as it continued over the Greenland Sea to dissipate off northern Norway.

There was a series of frontal waves on the front out of extratropical David as the front stretched southwestward off the North American coast parallel to the upper air flow. By midday on the 11th the wave had deepened into a 1006-mb closed circulation. The center passed within a few miles of OWS Lima, which registered 999 mb and winds of 35 kn on the 12th at 0600. The ATLANTIC PROJECT and the DAKE were near the same position south of the center at 1200. They registered 989 mb on the barometer with the former having 52-kn winds and 20-ft seas, while the latter had 40 kn and 26 ft.

On the 13th tens of ships on the North Sea were reporting winds of gale force or better. Some had winds over 50 kn and waves up to 30 ft (fig. 48). The 75-ft fishing vessel CALEDONIA sank off Peterhead in northwesterly force 9 to 10 winds and very rough seas. An oil rig tender rescued the crew. On the 14th the storm was over Finland and the cyclonic circulation still reached the North Sea, but the winds there had decreased considerably. Not so over the Baltic Sea. The 496-ton ANNIKA M. listed at 45 degrees in force 8 winds, and her cargo shifted. The crew abandoned ship and were rescued. The tug AXEL towed the vessel to sheltered waters.

This storm came out of the Northwest Territories of Canada and was over the Gulf of St. Lawrence on the

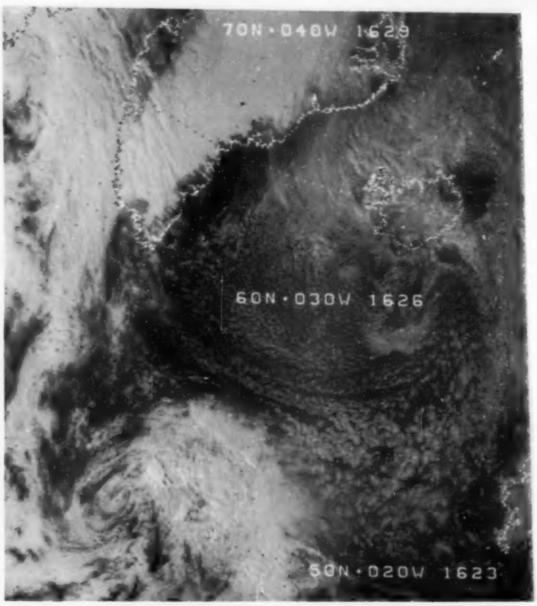


Figure 47.--The cloud cover of this storm centered over Iceland is not as dense as that of the frontal wave moving around the southern periphery.

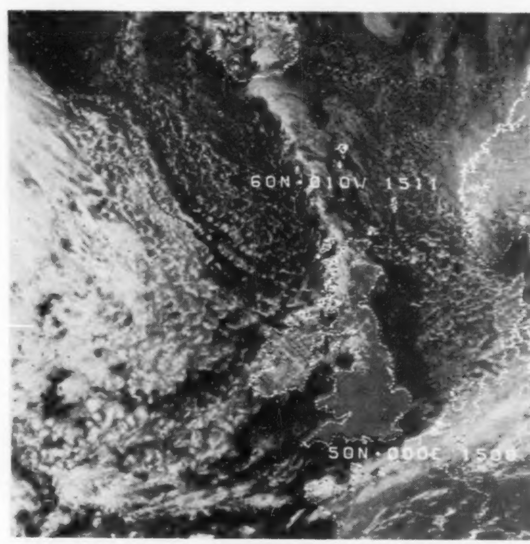


Figure 48.--The storm center is over Scandinavia and off the satellite track at 1511/13. Only scattered cumulus marks the severe weather over the North Sea.

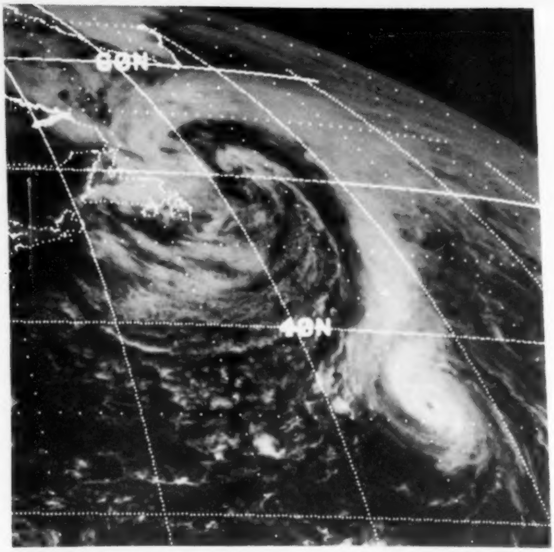


Figure 49.--At 1700 on the 13th the extratropical storm is near 50°N, 50°W. Hurricane Gloria is near 35°N, 45°W, on a collision course with the front.

Figure 50.--The short-lived storm near Davis Strait has already disappeared, but another LOW can be seen over northern Baffin Bay and also the new LOW along the east coast of Greenland.

11th. SEDCO 707 near 51°N, 51°W, measured 44-kn winds on the 12th. On the 13th the SIR ROBERT BOND (50°N, 55°W) had northerly 47-kn winds as the 992-mb storm pushed northeastward. At 1200 on the 14th the extratropical storm was due north of tropical hurricane Gloria (fig. 49). Lima had 40-kn southerly winds on the 15th. Icelandic fishing vessels were reporting gales. The storm brushed the south coast of Iceland that night. The storm raced into the Greenland Sea. On the 16th the 138-ton trawler KIRVIK sank in the North Sea when the cargo shifted in heavy weather.

This was the extratropical conversion of hurricane Frederic. The storm moved up the west side of the Appalachian Mountains. On the 15th the LOW was near Quebec. The circulation was elongated along the coast. The CANADIAN OWL was off Cape Hatteras in 38-kn southwesterly winds and 30-ft seas and swells. Winds were generally in the gale category. A ship reported 20-ft waves off Newfoundland on the 16th. The CAPE ROGER had 50-kn winds and 25-ft waves as the storm passed to the south. OWS Charlie measured 21-ft swell waves. At 1200 on the 17th the 974-mb storm was south of Iceland. It had a large circulation north of latitude 50°N. On the 17th and 18th there were reports of waves near 20 ft. As the storm passed near the Faeroe Islands it suddenly disappeared. The 499-ton AUSTRI capsized on the 19th south of Sognefjord in heavy weather associated with the remaining cyclonic circulation. Four of the nine crewmembers were saved.

This storm was the combination of three LOWs. They were all headed toward the Labrador Sea. At 1200 on the 20th, one was near Cape Chidley, another over the Davis Strait, and the third near Goose Bay. The SEDCO 707 reported 38-kn winds.

By 0000 on the 21st these three centers had combined into one 975-mb center off Godthab, Greenland. A ship with 982 mb south of the center had 35-kn winds. Another in Davis Strait had 44 kn out of the north. OWS Charlie was on the outskirts of the storm with 39 kn and 20-ft seas.

The storm had been traveling northward, but late on the 21st it was drawn back southward as another LOW formed on the east coast of Greenland. On the 22d the original storm disappeared (fig. 50).

This storm came out of central Canada moving parallel to the Canadian border. The center moved over the Labrador Sea on the 22d. On the 23d a ship near 55°N, 50°W, in the southerly flow had 20-ft seas. The DORDRECHT was farther west with 35-kn winds and 16-ft swells. The CAST BEAVER (53°N, 40°W) was sailing into 40-kn winds and 20-ft swell waves.

As the 984-mb storm traveled between Kap Farvel and Iceland, a wave moved east of Newfoundland and the gradient between the wave and the Azores High tightened. The PACIFIC HIGHWAY was in that area with 40-kn winds and 26-ft swell waves. On the 24th this 972-mb storm was centered near Iceland. It was the major cyclonic circulation over this ocean. A Belgium ship south of Iceland and west of the Shetland Islands had 21-ft waves. The DELTA DRECHT (59°N, 36°W) was contending with 42-kn winds, 20-ft seas, and 36-ft swells. Over on the Labrador Sea a trough passed the PETREL at 55°N, 58°W, with winds over 50 kn. The LOW was moving northward over the Greenland Sea, but the SPEY BRIDGE was still being affected by it at 51°N, 39°W, with 50-kn winds and 26-ft waves. The storm then turned eastward and moved over the Barents Sea. The 499-ton WHESTTRADE encountered winds of force 11 to 12 between Archangel and Warrenpoint, Ireland, and 71 packages of timber were lost overboard. The 1,589-ton GALLIC MINCH

encountered heavy weather near Norway on the 26th, and the starboard anchor tore off double plating.

This last storm of the month was first found over Goose Bay on the 27th on the 0000 analysis. In 12 hr the pressure dropped from 996 mb to 987 mb as it moved southeastward and the circulation expanded. This expansion included a frontal wave near 44°N, 43°W. The ADMIRAL WILLIAM M. CALLAGHAN and the SEA-LAND GALLOWAY were on opposite sides of the wave with 40-kn winds and 18-ft seas, respectively. By 0000 on the 28th the 970-mb storm was near 53°N, 44°W. OWS Charlie had 45-kn winds blowing heavy rain and 21-ft seas. Many ships had gales. During the day other ships had winds over 50 kn and waves as high as 33 ft. These included the ASIAN FOREST and the DART ATLANTIC. The wind-wave analysis showed a large area near 50°N between 40° and 50°W with seas over 18 ft.

The storm system was moving eastward very slowly (fig. 51). Several ships had waves over 30 ft as did OWS Charlie. The highest noted was 39 ft near 47°N, 45°W. Winds in the 40-kn and waves up to the 20-ft range continued into October 1. The storm was now traveling northward and weakening. Swell waves of 20 ft were still attacking Charlie. By the 3d the storm dissipated over Greenland.

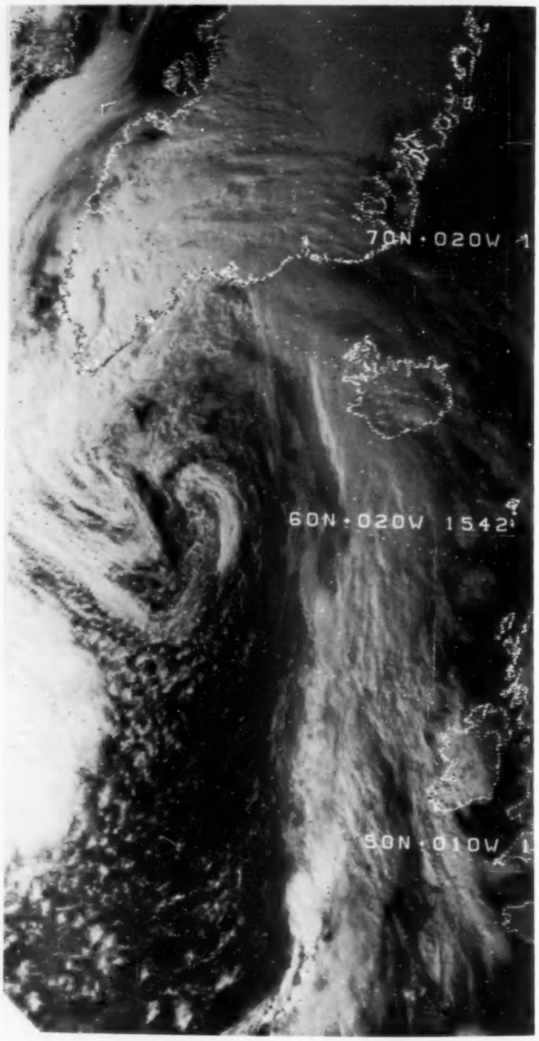


Figure 51.--The severe storm was near 58°N, 31°W, at 1542 on the 29th. The north-south cloud shield is associated with the occluded front. A frontal wave supports the clouds to the lower left.

Tropical Cyclones--Hurricane Gloria began her life at sea some 1,200 mi northwest of the Cape Verde Islands on the 6th. Moving northwestward, Gloria became a hurricane the following day. She maintained minimal hurricane intensity (65 kn) until the 10th when she slowed and weakened. After meandering for a few days, Gloria regrouped and headed northeastward, once again a hurricane. On the 13th, about 180 mi south of the storm's center, the PJVL encountered 40-kn winds and 13-ft seas (fig. 49). Gloria continued to intensify and as she passed some 300 mi west of the Azores early on the 14th, winds near her center climbed to near 90 kn. However, cool, dry air was entering her system, and winds began to decrease. The following day she was absorbed by an extratropical LOW several hundred miles southwest of Ireland.

On the 14th hurricane Henri began, as a tropical depression, just off the northeast coast of the Yucatan Peninsula. He meandered into the Bay of Campeche, where he reached tropical-storm strength on the 16th and became a hurricane the following day. After moving toward the southwest he turned northwestward then eastward. Movement was slow and erratic. Henri remained at minimal hurricane intensity with central pressure dropping to about 984 mb during the day. By early on the 18th he fell to tropical-storm strength some 150 mi southeast of Tampico. After meandering again for 2 days, the tropical depression finally moved slowly toward the northeast. On the 24th, it was absorbed by a frontal zone some 325 mi west-southwest of Tampa.

Casualties--The 35,588-ton American tanker CHEVRON HAWAII (fig. 52) was struck by lightning and exploded on the 1st while unloading at Houston, Tex. Several persons were killed, and the fire spread to other facilities. The 425-ton Greek ARIS IV went aground on the 1st on the coast of Libya in fog. The 2,646-ton PACIFIC INSTALLER lost one anchor and 485 ft of anchor wire on the 6th at Maui field. On the 12th the 2,824-ton CARMEN DEL MAR and the ESCANDINAVIA collided in fog near Corunna. The Danish ferry KONG FREDERIK IX (4,084 tons) struck a pier at Puttgarden, West Germany, on the 20th in fog. Late on the 21st the 297-ton PULPA grounded in heavy weather south of Sognefjord. The crew was rescued by the BERGEN KREDS.

The 8,878-ton Greek STAMATIOS G. EMBIRICOS and the COTNARI collided in fog on the 24th in Constantza Roads. The 8,127-ton ALEX STEPHENS contacted the stern of the French destroyer DU CHAYLA in thick fog in the Suez Canal on the 25th.

Figure 52.--Billows of black smoke pour out of the burning CHEVRON HAWAII after she exploded when struck by lightning during a thunderstorm. She was unloading a cargo of oil distillates at oil docks on the Houston ship channel. Wide World Photo.

Rough Log, North Pacific Weather

August and September 1979

ROUGH LOG, AUGUST 1979--The number of cyclone centers traversing the North Pacific appeared to be near normal, but the paths they followed did not match climatology so closely. Two storms did follow the primary climatological track from Japan to the Gulf of Alaska as closely as could be expected. The primary storm track out of eastern Asia usually crosses the Gulf of Terpeniya, but this month it was north of Sakhalin Island. These storms generally dissipated as they crossed the Sea of Okhotsk. The Bering Sea had its share of storms; four storms passed through or near the Bering Strait, one from the northwest.

The dominant feature of the mean sea-level pressure for the month was the Pacific High, even though it was weaker than normal. It was broken into three centers with one of them 1021 mb near 46°N, 145°W. This produced a sharp ridge into Alaska and positive anomalies over the Gulf of Alaska. There was a minus 5-mb anomaly center between Alaska and Hawaii. The normally weak Aleutian Low of 1008 mb was positioned normally east of Kamchatka at 1002 mb. A second 1002-mb low center was over the northern tip of Sakhalin Island. These resulted in a large minus 8-mb anomaly over that area. An anomalous 1009-mb HIGH was over northern Korea.

The long-wave trough at 700 mb was broader this month than the long-term normal. A closed LOW over eastern Siberia replaced the normal trough out of a LOW over the pole. The ridge over western Canada and Alaska was more pronounced this month. Over the northern latitudes the anomaly centers were positive over Alaska and negative over the Sea of Okhotsk. In the middle latitudes the anomalies were smaller and the signs reversed.

There were four tropical cyclones over the North Pacific, hurricanes Enrique and Fefa in the east and typhoons Irving and Judy in the west.

Extratropical Cyclones--Although the Pacific High was the dominant feature of the weather maps covering the North Pacific, it generally did not become well organized with a large, deep center. Instead, it was broken into multiple centers, and when it covered a large area the pressures were not exceptionally high. Several LOWs were able to disrupt it between latitudes

35° and 45°N off the U. S. West Coast. No low-pressure center penetrated the North American coast south of 60°N latitude. One crossed Alaska into Canada.

The first storm of the month was over the Kamchatka peninsula on the 1st. It drifted northward and then southward on the 3d before resuming a northeasterly track on the 4th. At this time it was 988 mb near Ostrov Beringa. In the meantime the SHINKO MARU had reported 43-kn southerly winds south of Unimak Island on the 3d. On the 4th the ASIA BOTAN near 51°N, 165°W, found 52-kn winds as a small frontal wave developed. On the 5th at 0000 the storm was 995 mb west of Mys Navarin. The ELBE EXPRESS near 54°N, 177°E, had 35-kn winds and 20-ft waves pounding her port beam. The ISOKAZE MARU was farther north at 57°N, 177°W, heading into 40-kn winds and 16-ft waves. The storm moved over the Seward Peninsula and disappeared.

This was another case of a wave forming on a warm front. It was first analyzed late on the 4th over the Sea of Japan. The wave traveled eastward and passed north of a Japanese ship on the 5th producing 13-ft waves. It now turned northeastward as it was diverted by a 1035-mb cell of the Pacific High over midocean. By 0000 of the 8th the storm was 994 mb north of the Rat Islands. The KEA was south of Atka Island with 38-kn winds and 13-ft waves. At 1200 the JAPAN BEAR (48°N, 172°W) had gales. The PACIFIC HIGHWAY at 48°N, 173°W, was southwest of the 987-mb center at 0000 on the 9th with 40-kn winds and 30-ft seas. Another ship closer to the center had 16-ft swells (fig. 53).

On the 10th the LOW was near the Shumagin Islands and a Japanese ship (JHSE) south of Dutch Harbor had gales and 20-ft swell waves. The fishing vessel DARING south of Unimak Island radioed a weather report of 40-kn northwesterly winds and 8-ft waves. The storm dissipated on the 12th over the Gulf of Alaska.

Figure 53.--At 2046 on the 9th the storm was stirring the waters south of the Alaska Peninsula.

This LOW formed east of the Kamchatka Peninsula on the 13th on the east side of a continental LOW that stalled over the northern Sea of Okhotsk. On the 14th it was over the central Bering Sea at 988 mb (fig. 54). The gradient near the center was flat, but it tightened in the latitude belt of 45° to 55°N. The MARITIME BRILLIANCE was near the center of that belt near 50°N, 165°W, with 45-kn winds and 12-ft waves. She was sailing westward and on the 15th had 50-kn winds near 172°W with the waves increasing to 15 ft. At 1800 the MOBIL MERIDIAN was near Middleton Island with 43-kn winds. On the 16th the ARCO FAIRBANKS and EXXON NEW ORLEANS also reported 40 kn. Late that day the storm disappeared over Kodiak.

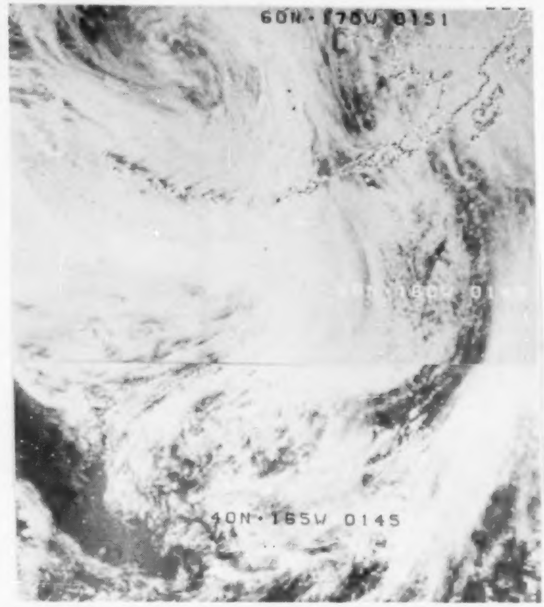


Figure 54.--The storm produced widespread cloudiness. Note the clear areas to the lee of some of the Aleutian Islands.

Another LOW that formed east of Kamchatka with a mate on the west side. The wind direction measured on Ostrov Beringa on the 18th tipped off its formation. It immediately was caught in northwesterly upper air flow and followed a track to the southeast. Two Japanese ships had 38-kn winds south of the center near 43°N and the Date Line. The CANADA MARU (43°N, 175°W) reported 40 kn. At 1200 the MAERSK CADET was not far away (42°N, 173°W) with 20-ft waves. The LIPSCOMB LYKES found 38-kn winds on the 20th in that same general area (41°N, 176°W).

The storm was pushing against the 1029-mb Pacific High, and this wasted its energy and led to its defeat on the 22d. Early that day the THOMAS E. CUFFE was in the persistent southerly flow between the pressure centers and found 33-ft swells.

The last third of the month the main cell of the Pacific High was over midocean, and the area off the U.S. West Coast supported multiple centers. On the 25th a southwestward trough out of a LOW off northern California expanded southwestward, and a new center formed north of Hawaii. On the 27th the LUCID STAR was west of the 1006-mb center in northeasterly flow with 60-kn winds, thunderstorms, and 21-ft seas.

On the 28th this center dissipated, but another one formed to the west (fig. 55). A ship reported 35-kn winds west of the new center. The PRESIDENT KENNEDY (45°N, 159°W) was north of the center on the 29th with 40-kn northeasterly winds and 13-ft waves. The LOW dissipated as it approached the coast.

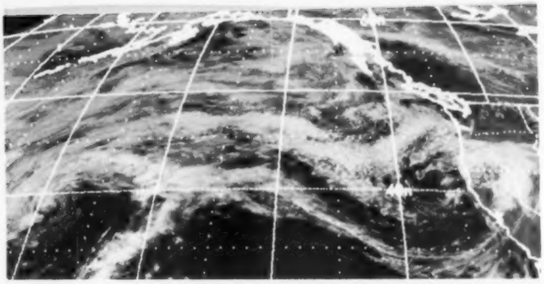


Figure 55.--The storm center almost made the coast by late on the 28th. Extensive clouds are indicated over Oregon and northern California.

As the previous LOW moved westward, another formed nearer midocean on the 29th. It moved southeastward for a more direct alinement with the cut-off upper air LOW. On the 30th the whole system reversed direction and started moving westward. The LUCID STAR was northwest of the center with 39-kn easterly winds and 12-ft seas.

On September 1 the storm turned northward, drawing a frontal system into its circulation. Two ships had gales, one of them north and the other south of the 998-mb center. By 0000 on the 2d the pressure was 990 mb near 44°N, 171°E. The RIVER ROSE (45°N, 163°E) was in the northerly flow west of the center with 74-kn winds and waves of 26 ft. Other ships including the PRESIDENT JEFFERSON were not far away with gales to 40 kn and waves to 20 ft. On the 3d the JAPAN BEAR near 40°N, 164°E, found 50-kn winds with 23-ft seas and 30-ft swells. The PACIFIC VENTURE was south of the LOW with 35-kn winds and waves up to 23 ft. The LOW had looped counterclockwise around a center near 42°N, 170°E (fig. 56).

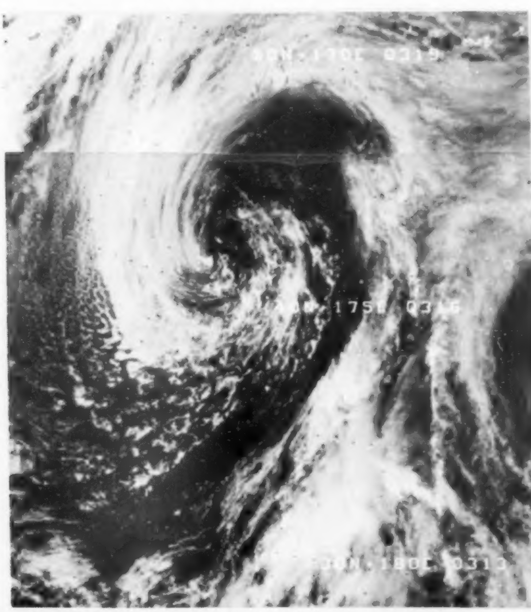


Figure 56.--The storm has the appearance of a giant centrifuge with the clouds (moisture) flung out to the edges.

On the 4th, 5th, and 6th minimal gales were reported with maximum waves of 23 ft and two isolated 40-kn reports. The storm began loosing strength on the 6th.

Tropical Cyclones, Eastern Pacific--Hurricane Enrique formed on the 17th just west of Clipperton Island. Moving west-northwestward, he reached hurricane strength on the 19th just before crossing the 120th meridian. Winds remained at 65 to 70 kn near his center until the 21st. During the next 2 days Enrique grew explosively as winds climbed to an estimated 125 kn by the 22d (fig. 57). The following day, as Enrique crossed the 20th parallel near 131°W, he began to weaken rapidly. By the 24th he was just a depression.

Meanwhile, hurricane Fefa was also dissipating that same day some 1,200 mi to the east. Fefa had come to life on the 21st near 14°N, 101°W. Taking a west-northwesterly course, she reached hurricane intensity late on the 22d. Winds climbed above 100 kn the following day after Fefa crossed the 115th meridian near 17°N. This only lasted for a brief time. On the 24th Fefa dropped all the way to a tropical depression.

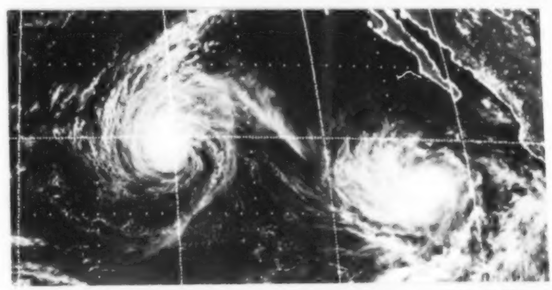


Figure 57.--Hurricanes Enrique and Fefa play follow the leader.

Tropical Cyclones, Western Pacific--Typhoon Irving developed in the friendly confines of the Philippine Sea. First spotted on the 9th, Irving headed westward then north-northwestward. He reached typhoon strength shortly after crossing the 20th parallel near 127°E on the 13th. The following day, sporting 85-kn winds, Irving moved through the southern Ryukyu Islands about 150 mi east of Taipei, Taiwan. The PRESIDENT KENNEDY encountered 30-ft waves south of Okinawa.

While Irving passed far east of the Philippines heavy rains from his circulation swamped about 30 towns in the northern Philippines, resulting in giant mud and rock slides. Six deaths have been reported. In Manila more than 14 in of rain fell in 24 hr. Landslides blocked the main road to the mountain resort of Baguio, where 80 families were evacuated from flooded homes. About 10,000 people were forced to flee their homes. Most of the evacuees were from Bataan across Manila Bay, where seven towns were in waist-deep water. In Taiwan heavy rains flooded low-lying areas in the Taipei suburbs but caused no casualties or serious property damage.

Moving northward through the East China Sea on the 15th and 16th, Irving maintained 90- to 95-kn

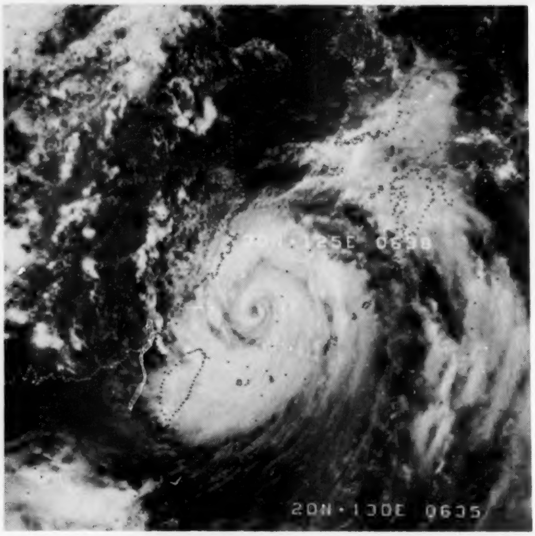


Figure 58.--On the 15th Irving is centered very close to Okinawa.

Figure 59.--Judy is a supertyphoon as she crossed the Tropic of Cancer.

winds (fig. 58). The KOWLOON BAY had 30-ft swell waves in Luzon Strait. On the 17th Irving closed in on South Korea's west coast. South Korea suffered heavy damage, while Irving took off through the Sea of Japan. Along the Russian coast, strong winds and heavy rain disrupted communication and caused flooding around Valdivostok, Spassk, and Ussurisk. Wind gusts reached 74 kn.

Irving weakened as he moved into the Sea of Okhotsk.

While Irving was turning on South Korea on the 17th, typhoon Judy popped up near Guam. She moved west-northwestward, then recurved toward the northwest, and ended in the same general area as Irving. However, Judy became a supertyphoon on the 19th after crossing the 20th parallel near 134°E. At her peak on the 20th, winds near her center were estimated at about 135 kn with gusts to 165 kn and gales extending to as much as 200 mi (fig. 59). Judy moved into the East China Sea about 100 mi southwest of Okinawa on the 22d. The NEPTUNE TOPAZ fought 33-ft swells southeast of Kyushu. Judy's winds had fallen below 90 kn. Naha, Okinawa, reported gusts up to 75 kn; over 4 in of rain fell in 7 hr. Heavy rains reached as far north as Honshu. In Japan Judy was blamed for 11 deaths, mainly due to floods and landslides. Up to 9 in of rain was reported in the northern Alps and the Kamikochi region. The SATSUMA MARU was east of Taipei fighting 51-kn winds, 20-ft seas, and 39-ft swells. On the 24th Judy brushed Shanghai. Although her winds were of minimum typhoon intensity, they along with heavy rains sunk fishing vessels, demolished houses, and triggered floods.

On the 25th and 26th while she was weakening, Judy had enough punch to batter South Korea's southern coastal areas with heavy rainstorms. The nation's three major rail lines closed down after landslides buried part of their tracks. At least 115 people were killed and 35,000 made homeless by floods and landslides. Judy finally blew herself out in the Sea of Japan.

Casualties--The 1,091-ton American fishing vessel BLUE PACIFIC grounded 30 mi from Kodiak on August 5. On the 11th she broke up in heavy winds and swells. A 342-ton American fishing vessel struck rocks in fog at June Island, Alaska. The Liberian-registered SILVER SHELTON (10,039 tons) requested survey of heavy weather damage on the 10th upon arrival at Yokohama. The 70,334-ton Liberian bulkcarrier STOIC ran aground 100 mi north-northeast of Ishigaki on the 19th. The crew was taken off and a salvage tug departed as typhoon Judy passed close by.

Other Casualties--The GULF PROSPERITY sank on the 3d in the Indian Ocean after being battered by a cyclone. The 23 crewmembers were rescued. The Panamanian UNITED FORTRESS grounded near 21.8°N, 90.6°E, in bad weather on the 7th. About a week later it was reported that over 100 fishermen drowned in another storm while returning the 20 mi to shore from looting the vessel. The Taiwanese CHAO FONG sank during a monsoon storm in the Bay of Bengal on the 8th. The Panamanian AL TANVIR was damaged in heavy swell at Matarani Port on the 10th. The Spanish tanker ALCAZAR was towed farther to sea after she lay helpless in mountainous swell 19 mi off Cape Town. She sent a distress call that she was adrift without steering in 45-kn winds. The Pakistani OHRMAZD arrived Kenya reporting heavy weather damage from the 5th to the 13th. The Kuwaiti AWATIF AL SABAH lost anchor and chain at Bhavnagar, India, with strong monsoon winds and currents. The British bulkcarrier ALARIC alleged heavy weather damage between the 13th and 20th upon arrival at Durban on the 22d. The Australian AUSTRALIAN EXPORTER encountered heavy weather on the 25th to the 27th north of New Zealand and lost the port anchor and 11 lengths of cable.

ROUGH LOG, SEPTEMBER 1979--There were several large, deep storms this month. This seems earlier than usual in the fall season for their development. There were two distinct primary storm paths. The southern one was from west of Tokyo eastward and then northeastward into the Gulf of Alaska. The other was from the Kuril Basin northeastward into the Bering Sea. There also was a secondary track out of Asia and across the Sea of Okhotsk into the Bering Sea. These tracks grossly matched the climatological tracks. The primary track into the Bering Sea corresponded to a climatic secondary track.

The mean sea-level pressure pattern matched the climatic mean closer than the storm tracks. The 1003-mb Aleutian Low was near the Shumagin Islands east of the Alaska Peninsula. Its 1006-mb climatological counterpart is south of Bristol Bay and west of the Alaska Peninsula. The Pacific High was 1021 mb, which matches climatology. It was centered near 34°N, 158°W, which is about 600 mi west of its normal location. There was an anomalous 1019-mb high-pressure center near 32°N, 160°E, which produced a large anomaly area of about 3 mb stretching southeastward from northern Japan to approximately 180°.

There were two principal negative anomaly centers over the northern ocean. The largest was minus 6 mb over the Gulf of Alaska near 52°N, 150°W, and the other was minus 4 mb over the western Bering Sea north of the Near Islands.

In the upper air at 700 mb the flow was mainly zonal between latitudes 35° and 55°N. The constant pressure surface was generally higher than normal south of 40°N and lower than normal north of that latitude. The major trough stretched from the North Pole southward across the Bering Strait into the Bering Sea. There was secondary troughing on both the east and west sides. This troughing was especially pronounced off the west coast with an attendant sharpening of the normal ridge over the West Coast mountains.

Hurricane Guillermo was over the eastern Pacific. The western Pacific hosted six cyclones: typhoons Lola and Owen and tropical storms Ken, Mac, Nancy, and Pamela.

Extratropical Cyclones--This storm was the extra- the 1st. stage of tropical storm Ken, which began on August. Ken turned extratropical on the 4th over Honshu. By 0000 on the 6th the storm had dropped to 984-mb pressure near Ostrov Simushir. At 1800 on the 5th Russian ships on the Sea of Okhotsk had started reporting winds up to 58 kn. These strong winds on the western side of the storm continued with wave reports from some ship building to over 20 ft. A ship near the warm front in the eastern half near 45°N, 156°E, reported 23-ft swell waves. At 1200 the CHITA MARU also near the warm front but at 45°N, 163°E, had 38-kn winds with 30-ft swell waves, 70° out of phase with the southeasterly wind waves. By the 7th the swell waves had increased to 33 ft and were nearly in phase with the wind waves (fig. 60). The storm was traveling northeastward and filling. On the 8th it moved into the Bering Sea and dissipated on the 10th.

This storm was the offspring of a combination of a frontal wave with dissipating tropical cyclone Lola on the 8th. At 0000 on the 9th the THOMAS E. CUFFE was 120 mi south of the wave with 45-kn winds and 20-

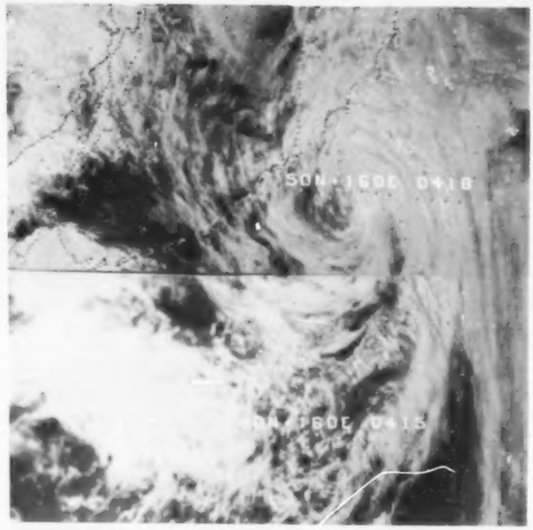


Figure 60.--The storm was southeast of Mys Lopatka at this time on the 7th.

ft seas. The storm continued an easterly track until the 11th with winds under gale force and then turned northeastward. On the 11th the winds started increasing as did the waves. At 1800 the NOPAL LANE found 26-ft swell waves in the southeast quadrant of the storm, while the YAMASHIN MARU nearby had 50-kn winds and 16-ft waves.

The storm was now deepening rapidly, and at 0000 on the 12th the 965-mb storm was near 47°N, 156°W, occupying a large area of the ocean (fig. 61). The ZENKOREN MARU (42°N, 155°W) had 46-kn winds and 16-ft waves, while the HIEI MARU (44°N, 155°W) had 35 kn and 26-ft swell waves. The GLACIER BAY not far away had 40 kn and 16-ft swell waves, which topped 39 ft at 1800.

On the 13th the storm was over the Gulf of Alaska. A ship near 51°N, 139°W, had 54-kn winds out of the south. The PRIOZERSK 550 mi away from the center in the southwest quadrant had 50-kn winds. The PAC-PRINCESS over the Gulf found 30-ft swells rolling from the south. Early on the 14th the storm was still

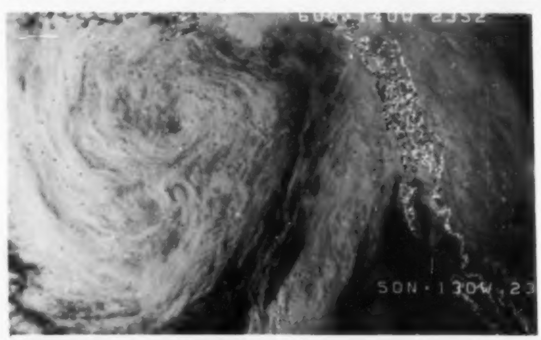


Figure 61.--Both the high-level and surface centers of circulation can be seen in this image. The upper air center is near 53.5°N, 151°W. The surface center is near 51°N, 149°W.

able to produce 50-kn winds as attested to by the PACIFIC VENTURE and the TOYOTA MARU, which also found 25-ft swells east of the storm. The storm was dying rapidly as it turned northwestward across the Alaska Peninsula.

This was a long-lived storm. It took many ship reports to trace its path from Japan to the Gulf of Alaska. The first indication of the LOW was a frontal wave to the south of Tokyo. It slowly traveled east-northeastward under the influence of upper zonal flow. By the 13th it had developed a considerable circulation, but the winds and waves were not severe. At 0600 on the 14th the first significant wind and wave report of 45-kn winds and 20-ft waves was received from the YAMASHIN MARU (44°N, 175°E) near the center of the storm.

When the preceding storm crossed into the Bering Sea and weakened, this storm blossomed. At 0000 on the 16th it was 981 mb near 53°N, 157°W. The report from Adak Island indicated winds of 60 mi/h. The TOMEI MARU (51°N, 154°W) found 48-kn winds. The ATLANTIC PIONEER (51°N, 165°W) was buffeted by 23-ft waves. A German ship also had 23-ft waves almost 300 mi south of the LOW on the 17th. The higher winds were blowing around 40 kn. An American ship was sailing toward the LOW with 25-ft waves. The storm turned sharply eastward on the 17th and weakened as it broke away from its primary upper air support.

Another of those situations where a LOW splits across a peninsula or sharp point of land. This LOW east of the Kamchatka Peninsula split off another LOW that was over the Sea of Okhotsk on the 16th. By 1200 on the 17th it was 980 mb near 57°N, 172°E. The GOLDEN BEAR was far to the southeast with 40-kn winds.

Among the contributors on the 18th were the ASIA HONESTY, PACIFIC VENTURE, and TOYOTA MARU. They reported winds up to 43 kn and waves up to 20 ft. A Japanese ship in the southerly flow reported swell waves of 43 ft from the southwest. The ATLANTIC PIONEER (51°N, 180°) over 500 mi south of the 978-mb center had 29-ft waves. The storm was moving eastward along 60°N. On the 20th the storm skirted Cape Romanzof and sank in Norton Sound.

Northern China produced this storm. It moved over the Tartar Strait on the 18th and the Kuril Islands on the 19th. At 0000 on the 20th the analysis showed a 995-mb central pressure, and the AMAX MACGREGOR at 47°N, 162°E, indicated 995 mb with 36-kn winds and 23-ft waves. At 0600 a SHIP near 48°N, 166°E, had 990 mb with 55-kn winds. They didn't venture out to check the waves. By 0000 on the 21st the 980-mb storm had traveled to 51°N, 178°E (fig. 62). The PACPRINCESS was near 50°N, 173°E, with 40-kn winds and 36-ft waves. Farther to the southwest the ATLANTIC PIONEER (47°N, 172°E) was in 45-kn winds and 25-ft waves.

Figure 62.--The storm was caught very near to the Date Line. One part is occurring on Thursday and one on Friday.

The storm was moving along the Alaska Peninsula on the 22d at 980 mb. The PORTLAND was sailing southeastward with southerly 50-kn winds and 20-ft swells out of the southwest. The storm moved northward across western Alaska and into the Chukchi Sea on the 24th.

Another of those storms that was split by the Kamchatka Peninsula. The original LOW had come out of northern Manchuria. This was a deep LOW and strong storm at its inception late on the 23d. The cyclonic circulation was already present, only the center changed. At 0000 on the 24th it was 970 mb near Ostrov Mednyy. One of the Kuril Islands measured 40 kn. A Soviet ship (USZL) (49°N, 154°E) radioed 54-kn winds and 41-ft waves. The NELSON MARU (51°N, 168°E) had 52-kn winds, but only 18-ft seas. At 0600 the HERCULES BULKER at 47°N, 164°E, reported winds of 60 kn.

At 1200 on the 24th Ostrov Beringa measured 50-kn winds, and a ship at 53°N, 174°E, had a pressure of 965 mb and 50-kn winds. The storm was near the center of the Bering Sea on the 25th and the pressure had dropped to 958 mb. The HIRO MARU (52°N, 177°W) reported 59-kn winds. Several ships inside the 1000-mb isobar had 50-kn winds and many gale reports. On the 26th the storm stalled near 62°N, 172°W, and fizzled away until it disappeared on the 29th.

This was a fast-moving frontal wave on the front out of the storm above. This time the zonal flow sent it racing eastward. At 0000 on the 27th it raced by the BREWSTER at 39°N, 178°E, leaving a 53-kn memoir. The PRESIDENT FILLMORE received the same treatment at 1800 near 44°N, 159°W. The winds were only 40 kn, but the waves were 23 ft. The storm began to intensify rapidly on the 28th, which slowed its forward dash. The GLACIER BAY had 20-ft waves; winds were gale force.

The 976-mb storm was not so large or deep as the others, but it stirred up the water. The RIPON GRANGE (45°N, 144°W) found 55-kn winds, 33-ft seas, and 49-ft swells. The PRESIDENT FILLMORE (43°N, 148°W) in a lesser gradient had only 37-kn winds with 36-ft swells. The storm touched the Canadian coast at 0000 on the 30th and was gone by 0600.

The Sea of Japan spawned this storm on the 26th. After crossing Honshu it raced eastward across the water. The storm suddenly started deepening late on the 28th, and by 1200 on the 29th it was 964 mb near 49°N, 167°W (fig. 63). That day several ships had 50-kn winds and seas to 30 ft. Those reporting high winds and seas included the BENHOPE and VIOLET. Twenty-four hours later on the 30th the storm was 950 mb near buoy 46003. At 0000 a Japanese ship was within 5 mb of the center with 26-ft seas. The TSURUMI MARU was about 540 mi south of the center with 43-kn winds and 30-ft swell waves. The HAN WOO (54°N, 159°W) had winds over 50 kn and 33-ft seas. The RIPON

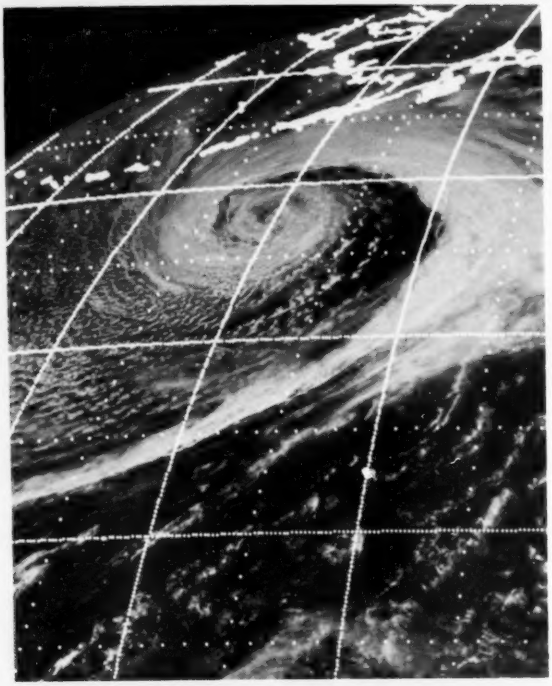


Figure 63.--There is no problem identifying the location of this storm, but it is hard to find the previous storm breaking up on the Canadian coast. The time was 2045 on the 29th.

GRANGE, 850 mi southeast of the center, reported 30-ft swell waves. At 1800 OWS Papa measured 40-kn winds and 26-ft seas.

The strong winds and high seas continued into October 1 as the storm entered the Gulf of Alaska. Papa now had 42 kn and 27-ft waves. At 1200 the storm was over Kodiak and weakening rapidly. It dissipated on the 2d as another LOW moved into its circulation.

Tropical Cyclones, Eastern Pacific--In this month's only action, hurricane Guillermo was first spotted on the 8th near 16°N, 100°W. He moved in a northwesterly direction, reaching tropical-storm strength on the 9th. The following day Guillermo, still a minimal tropical storm, crossed 20°N near 110°W. On the 11th he slowed and drifted northward. He also intensified briefly, reaching minimal hurricane strength for a few hours late on the 11th and early on the 12th (fig. 64). However, Guillermo then stalled and fizzled.

Tropical Cyclones, Western Pacific--The first warning on tropical storm Ken was issued on the 1st. He was just a depression some 240 mi east of Naha, Okinawa. Ken swung northward. He reached tropical-storm strength on the 2d as winds climbed to 45 kn. However, he was approaching Kyushu and was not able to strengthen further. Ken dissipated over southern Japan on the 4th.

Meanwhile, typhoon Lola was developing between Marcus Island and Iwo Jima. By late on the 4th she reached typhoon strength just before crossing the 20th parallel near 147°E. Lola moved northward then northeastward. Winds near her center reached 80 kn on the 6th. The following day she fell back to tropical-storm

Figure 64.--The image at 1200 on the 11th caught three hurricanes at the same time--Guillermo, Frederic, and Gloria.

strength after crossing the 30th parallel near 146°E. Fortunately, Lola remained far from land, and there were no shipping incidents reported.

After about a week's lull tropical storm Mac popped up in the Philippine Sea. On the 15th he was spotted near 13°N, 131°E. Before he banged ashore in the central Philippines on the 18th, big Mac generated 55-kn winds near his center. His trek across the islands, south of Manila, left him weak. Winds dropped below tropical-storm strength by the 20th. Mac was now heading northwestward across the South China Sea. By the 22d, on a course for Hong Kong, Mac regained tropical-storm strength (fig. 65). He moved into Hong Kong the following day. Heavy rains lashed the island and many roads were closed by fallen trees and landslides. Rain totaled more than 9 in in parts of the colony. At least one death was reported.

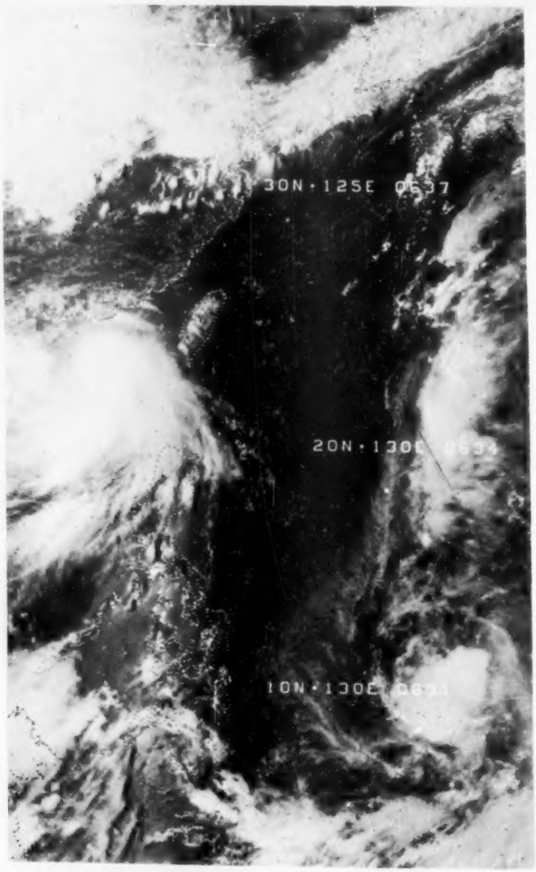


Figure 65.--Tropical storm Mac is east of Hong Kong early in the afternoon of the 22d.

Between the time that Mac left Manila and arrived in Hong Kong tropical storm Nancy had come and gone, and typhoon Owen had been born. Nancy kicked up just off the coast of Hainan on the 19th. After crossing the island she headed southwestward for Vietnam. A minimal tropical storm, Nancy brought heavy rain to the area just north of Hue. She fizzled as she continued across the rugged terrain into Cambodia on the 22d.

It was on this same day that Owen was discovered some 200 mi north of Yap. He developed as he moved along a north-northwestward track. Owen reached typhoon strength on the 24th after crossing the 20th parallel near 133°E. By the 27th he was generating 100-kn winds close to his center (fig. 66). The GENCIANO, carrying lumber from Borneo to the Japanese port of Hamada, sank in rough seas about 130 mi west of Okinawa. The 23 South Korean crewmen were plucked from a lifeboat by the container vessel SEALAND FINANCE.

Heading northward, Owen passed about 100 mi east of Okinawa, disrupting both air and sea traffic for several days. Ten large oil tankers were forced to leave Tachibana Bay to find refuge at sea as a slowly weakening Owen moved in on Kyushu. The storm made landfall over Shikoku on the 30th. Muroto on the southeast coast recorded a gust of 130 kn as Owen passed over. Waves nearly 33 ft high pounded the southern coast, while heavy rain triggered inland flooding. Owen dumped up to 17 in of rain in 10 hr. On Amami Oshima, south of Kyushu, 27 in of rain fell over the last 3 days.

From Shikoku Owen made the short hop to Osaka and mainland Japan on the 30th. He continued northeastward across Honshu as a tropical storm, and then moved back out to sea on the 1st. The damage to the island and shipping was heavy.

In his wake Owen left 8 people dead and 51 injured. Some 53 houses were damaged and more than 3,000 flooded. Landslides damaged roads and several communication links. Several ships either sank, grounded, or collided during typhoon Owen. The ZIJIN SHAN, taking refuge off Wakayama, dragged her anchor and struck the breakwater causing serious hull damage. The FORTUNE MARINER, taking refuge at Ise Bay, was driven aground. In the same waters the GOLDEN MIRANDA, a bulkcarrier, collided with the ITEL AMERICA when her anchor dragged. A similar accident occurred to the TRISAKTI and the HOTOKU MARU at Shimizu anchorage.

The last storm of the month was short-lived tropical storm Pamela. She was spotted on the 25th midway between Iwo Jima and Guam. As a minimal tropical storm, she traveled northwestward. The following day Pamela recurved northeastward and weakened rapidly.

Casualties--The 13,313-ton Greek bulkcarrier SEMI was due Niigata on the 6th with heavy weather damage. It was reported at Kobe on the 14th that a heavy weather damage survey had been requested for the 12,498-ton Greek AEGIS BRITANNIC. A sister ship, the AEGIS HEROIC advised that she sustained heavy weather damage on voyage from Romania to China.

The 10,039-ton SILVER SHELTON reported heavy weather damage on the 21st on a voyage to Nagoya. The 1,999-ton GENCIANO bound for Japan encountered heavy weather on the 27th about 125 mi northwest of Okinawa and sank. The SEALAND FINANCE responded to the distress call and rescued 23 crewmembers.

Other Casualties--A surveyor was appointed to inspect reported heavy weather damage to the 13,000-ton Liberian AL SAMAD at Basrah, Iraq. The Chief Officer of the 1,776-ton Panamanian INDUNA was rescued from

a liferaft 400 mi northeast of Durban after being adrift 24 days. He was picked up by the CONSTANTIA. The vessel sank about 50 mi south of Cap Ste. Marie after taking on water in heavy seas. Both lifeboats turned over when launched, and one self-inflatable liferaft was blown away.

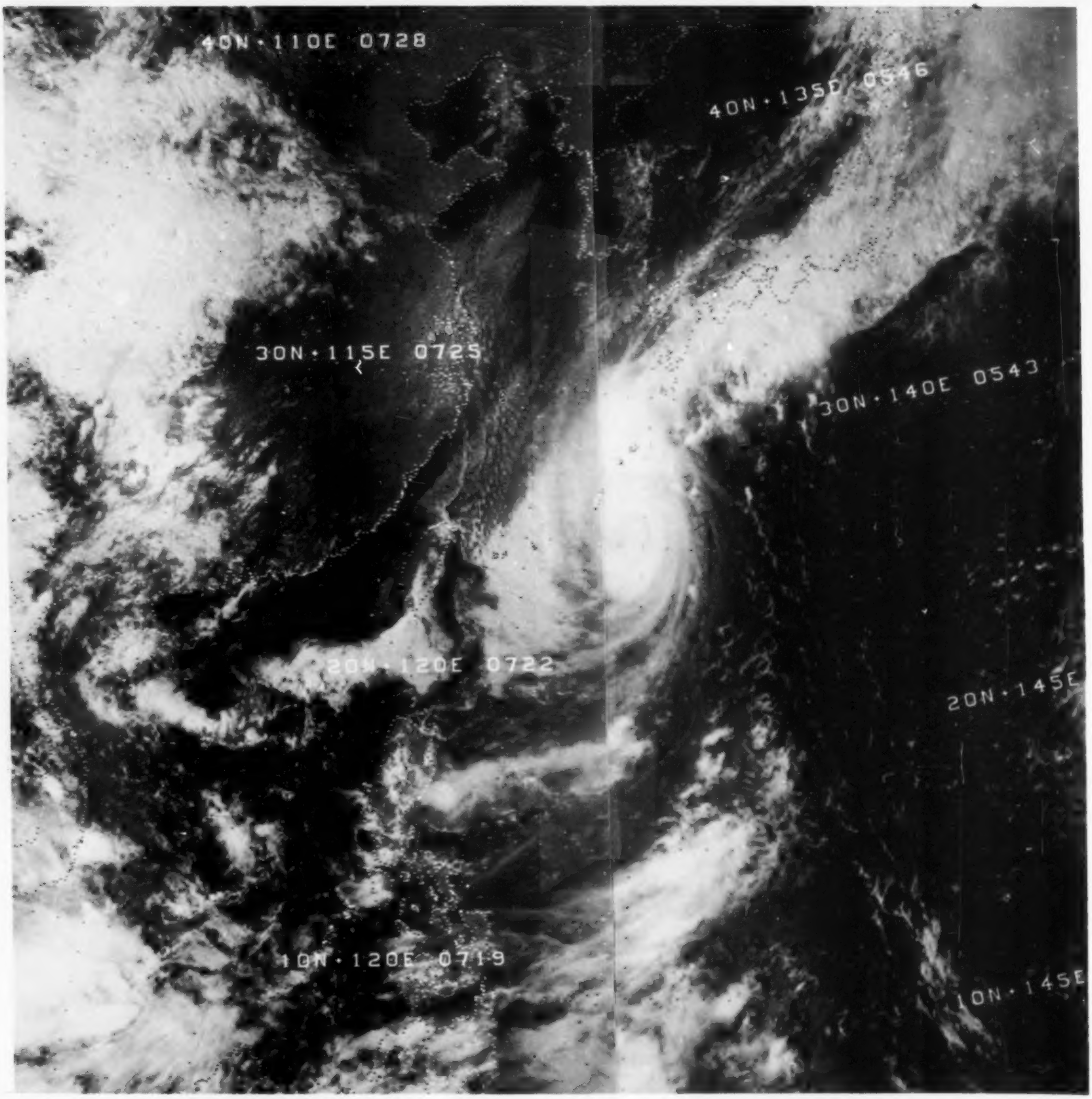


Figure 66.--Typhoon Owen was a very damaging storm, especially to Japan.

Marine Weather Diary

NORTH ATLANTIC, DECEMBER

WEATHER. December is generally one of the stormiest months of the year over the North Atlantic, particularly north of 35°N. Deep and extensive LOWs traverse the middle and northern shipping lanes, producing strong winds and high seas. Extended periods of rain, sleet, or snow usually attend these storms. A comparison with the normal pressure pattern of the preceding month shows that in December the Azores High remains at about 1021 mb and is centered near 35°N, 33°W. The Icelandic Low deepens 1 mb to 1001 mb; it is located near 62°N, 38°W.

WINDS from the westerly quarter prevail over most of the ocean north of 40°N. Speeds average force 5 to 6 over most western and central waters, and about force 4 over the Bay of Biscay and surrounding waters, the Baltic Sea, and the southern portion of the North Sea. Force 5 to 6 southeasterlies prevail over the northern half of the North Sea, while southerlies of force 4 to 5 are predominant off the central coast of Norway. Winds over the Norwegian Sea are variable at about force 5. Between 40° and 30°N, winds (force 3 to 4) are westerly or southwesterly west of 20°W, northerly or northeasterly between 20°W and the Strait of Gibraltar, and predominantly westerly over the Mediterranean Sea. The "northeast trades," also averaging force 3 to 4, persist between 30° and 10°N, except off the east coast of Florida where winds are variable at force 4. As in November, force 3 southeasterlies prevail over the extreme southern North Atlantic.

GALES. The occurrence of gales is more frequent over northern and middle latitudes than in November. Winds of force 8 or higher occur 10 percent or more of the time from about 34°N over the western North Atlantic to about 40°N over eastern waters. A 10-percent frequency of gales is encountered on the Mediterranean Sea within an area extending nearly 200 mi southeastward from the Gulf of Lions. The incidence of gales is less than 10 percent over the immediate waters east of Newfoundland and over the Davis Strait. Areas of maximum gale frequency--20 percent or higher--are found within an area from the Labrador Sea southeastward to about 44°N, 35°W, then north-northwestward to 56°N, 40°W, then eastward to 55°N, 24°W, then north-northwestward again to the cold waters off southeast Greenland; over much of the Norwegian Sea; and over the Gulf of Lions.

EXTRATROPICAL STORMS. Two primary storm tracks--one from the waters east of the United States Middle Atlantic States and one from the northern Great Lakes--converge over Newfoundland and then head toward Greenland, where they split into two tracks with one leading into the Davis Strait and the other heading toward Iceland. A large number of LOWs also head toward Iceland from the central ocean east of 40°W and north of 50°N. Another cyclone track enters the Davis Strait from Hudson Bay, while still another runs across the northern coast of Norway from the Norwegian Sea. A primary track stretching from the Gulf of Lions to west-central Italy and then east-southeastward to the south coast of Turkey influences the Mediterranean area. The Great Lakes have their highest cyclone frequency of the year during December. The frequency of cyclogenesis over the Gulf of Mexico also reaches it annual maximum during December.

TROPICAL CYCLONES. There is seldom a tropical storm on the North Atlantic in December. During the 48-yr period, 1931-78, only two were recorded; one of these reached hurricane strength.

SEA HEIGHTS of 12 ft or higher occur 10 percent or more of the time north of a line extending from the northwest coast of Spain to approximately 35°N, 70°W, and then east of a line joining that point with Nova Scotia. On the Norwegian Sea, however, sea heights $\geq$ 12 ft usually occur less than 10 percent of the time. Ten-percent frequencies are also found in the Mediterranean between Balearic Islands, Sardinia, Tunisia, and the French Riviera; between Sicily and Crete; and on the northern Aegean Sea. Maximum frequencies of 30 percent or more occur over the Denmark Strait and over much of the western and central ocean north of about 47°N and south of the 60th parallel. An isolated area of 20-percent frequency rests over the Gulf of Lions.

VISIBILITY. The frequency of visibility less than 2 mi climbs to 10 percent over the Labrador Sea, over a pocket-shaped area extending from Kap Farvel south-southwestward to the Grand Banks, over the southern and eastern Davis Strait, and over the southern North Sea. Frequencies of this low visibility are also greater than 10 percent over the area north of a line drawn from the Denmark Strait eastward across northern Iceland, then dipping southward to about 64°N, 7°W, then stretching north-northeastward over the Norwegian Sea, and then eastward to the northern coast of Norway. North of about 72°N, the frequency of visibility less than 2 mi increases to 20 percent and continues to increase as one moves eastward until, after reaching the southern Barents Sea north of the Soviet Union, frequencies reach a maximum of 40 to 50 percent.

NORTH PACIFIC, DECEMBER

WEATHER. December is usually a stormy month over North Pacific waters, particularly in the northern and middle latitudes. The normal pressure distribution is quite similar to that of the preceding month with the Aleutian Low (1001 mb) shifting to near southeastern Kamchatka.

WINDS north of 55°N blow mostly from a northerly direction at force 4 to 6, except over the Gulf of Alaska where force 4 easterlies prevail. Westerly winds of force 3 to 6 are usually felt south of 55°N to about 40°N over the extreme eastern ocean, 35°N over the central-eastern and midocean, and 30°N west of 165°E and east of Japan. Nevertheless, winds over the

southwestern Bering Sea show a tendency to be variable, and off the coast of British Columbia the prevailing wind is southerly. Steady "northeast trades" prevail (force 4) between 25°N and the Equator, except they extend to nearly 35°N off the southwestern California coast. These trade winds merge with the force 4 to 5 winds of the northeast winter monsoon near 140°E. Variable winds (force 3 to 4) lie in a narrow belt between the aforementioned westerlies and northeasterlies. Prevailing winds are largely from the north or northwest and average about force 4 over the Sea of Japan, and the Yellow Sea, and along the southeast coast of Japan. Northerly winds blow steadily out from the Gulf of Tehuantepec, off the south coast of Mexico.

GALES. A larger area of the North Pacific is subject to gales during December than in the preceding month. North of about 39°N over eastern and central waters and 32°N over western waters, 10 percent of the observations contain winds of force 8 or higher. The greatest frequencies, 20 to about 25 percent, occur in three scattered areas from the waters south of the southern tip of the Kamchatka Peninsula south-southeastward to about 34°N, 166°E. Farther north, the frequency of gales decreases to less than 10 percent over the Sea of Okhotsk and the Bering Sea. They are also under 10 percent across a triangularly shaped area southeast of the Aleutians bounded at 53°N, 162°W; 47°N, 163°W; and 49°N, 174°W. Gales are recorded between 5 and 10 percent of the time on the waters surrounding Taiwan, the southern Ryukyus, and the northern portion of Luzon as far east as 144°E, because of the strong development of the northeast monsoon. Gale-force northerly winds occur between 5 and 10 percent of the time out from the Gulf of Tehuantepec.

EXTRATROPICAL CYCLONES. Primary storm tracks extend from the northern portion of the Sea of Japan and the waters east of the Ryukyus to the ocean region lying between Kamchatka and the western Aleutians. From there, LOWs either pass near the Pribilof Islands or continue east-northeastward to the Gulf of Alaska. Another major storm track reaches the Gulf of Alaska from an area south of the Alaska Peninsula near 48°N. The only other primary cyclone track swings toward Vancouver Island from a point 450 mi west of the Oregon coast.

TROPICAL CYCLONES. One tropical storm usually develops over the western North Pacific during December. About two out of every three that do pop up go on to become typhoons. The most likely area of formation is in the neighborhood of the Caroline Islands. Contrary to the events of November, very few of these storms are able to maintain their identity over the South China Sea after traversing the Philippines.

Off the Mexican west coast, tropical cyclones are rare in December.

SEA HEIGHTS of at least 12 ft occur 10 percent or more of the time north of approximately 35°N, east of 150°E, and south of the Alaska mainland, the Aleutian Islands, Kamchatka, and 55°N on the Sea of Okhotsk.

VISIBILITY under 2 mi occurs 10 percent or more of the time north of a line drawn from the lower Tatar Strait to the central Kurils and then northeastward to the western Aleutians where it dips southeastward to about 47°N, 177°W. Upon reaching a point near 47°N, 165°W, the line bends generally northward to Cape Romanzof, Alaska. A much smaller area of 10-percent frequency is centered near 44°N, 143°W. Visibility less than 2 mi encompasses more than 20 percent of all observations poleward of a line cutting through the northern and eastern portions of the Sea of Okhotsk, the northern Kurils, and then northeastward through the Bering Sea to the Bering Strait (passing west of both the Komandorskiye Islands and St. Lawrence Island). A smaller area comprising a 20 percent or greater frequency lies north of the central Aleutians near 54°N, 173°W.

NORTH ATLANTIC, JANUARY

WEATHER. January is generally characterized by rough weather over the middle and northern latitudes of the North Atlantic. LOWs frequently become deep, and associated winds often reach gale and sometimes hurricane force. The Icelandic Low (1000 mb), centered off the extreme southeastern tip of Greenland, is deeper than at any other time of the year. The Azores-Bermuda High with a central pressure of about 1023 mb covers a band from the western Mediterranean Sea west-southwestward to the waters northeast of the Bahamas.

WINDS. North of 40°N, the prevailing winds are westerly over most of the ocean. Over the Norwegian Sea and the North Sea, winds from the southerly quarter prevail. The average wind speeds are predominantly force 4 to 6, except up to 1,200 mi south and east of the southern tip of Greenland and over the Labrador Sea where they reach force 5 to 7. Between 25° and 40°N, the wind direction is from the southwest quarter of the compass over the main body of that portion of the Atlantic, mostly easterly over the Gulf of Mexico, variable over the waters east of Florida, and northerly or northeasterly from west of the Iberian Peninsula to the Canary Islands. Westerlies still dominate over the Mediterranean Sea. Force 3 to 4 winds are the most common except off the coast of the middle Atlantic United States where force 4 to 6 winds prevail. From the Equator to 25°N, the "northeast trades" persist; more than 65 percent of the time wind speeds range from force 3 to 5, except south of 10°N where these winds blow more than 50 percent of the time.

GALES (winds force 8 and higher) occur in 10 percent or more of the observations north of 35°N over the western part of the ocean and north of 40°N over the eastern part. The Mediterranean Sea hosts 10-percent frequencies out to 150 mi from the Gulf of Lions, over the northern Adriatic Sea, and over most of the Aegean Sea. The highest frequency over all North Atlantic waters, 30 percent, is found over a small area centered at about 58°N, 30°W, over a narrow belt off the southern tip of Greenland between 38° and 52°W, and (because of the mistral) over the Gulf of Lions.

EXTRATROPICAL CYCLONES. During the winter months (December, January, and February) LOWs form most frequently in a band 150 to 250 mi wide

stretching from the North Carolina - South Carolina border northeastward to about the latitude of Cape Cod. This is part of a large area of cyclogenesis that extends from the Gulf coast of the United States northeastward to the Bay of Fundy. Other principal areas of cyclogenesis lie over the western half of the central ocean between Newfoundland and the British Isles, over most Icelandic coastal waters, over the inland waters east of the North Sea except the Gulf of Bothnia, and over the Mediterranean from the Gulf of Lions southeastward to the toe of Italy and then northward to the Yugoslavia coast. Cyclogenesis is more concentrated around the waters on both sides of central Italy than anywhere on the North Atlantic during winter with the exception of the band off the United States Atlantic coast. In January, primary storm tracks run from the Carolina capes to Cape Race and from Lake Superior to Cape Bauld. After reaching Newfoundland, cyclones either head northward to the Davis Strait or the Denmark Strait or northeastward to Iceland. Primary storm tracks are also present off the northern Norwegian coast, over the Mediterranean from the Gulf of Genoa to Cyprus, and over the eastern Great Lakes where they join the track toward Newfoundland.

SEA HEIGHTS greater than 12 ft occur 10 percent or more of the time north of 33°N over the western North Atlantic and north of 42°N over eastern waters. Frequencies greater than 10 percent also exist in a small area near Barranquilla, Colombia, and on the Mediterranean between Menorca and Sicily (not including the waters surrounding Corsica), south of Greece and west of Crete, and on the northern Aegean Sea. A large area of frequencies greater than 30 percent stretches from south of Iceland to west of Ireland to east of the Grand Banks and then northward to the waters southwest of Greenland and south of the waters between Greenland and Iceland. Smaller areas of similar frequency are found on the Denmark Strait and west of northern Norway near 67°N, 10°E. The frequency of sea heights greater than or equal to 12 ft decreases to less than 10 percent over a large portion of the Norwegian Sea north of 67°N between 5°E and about 13°W.

VISIBILITY less than 2 mi is noted in more than 10 percent of the observations from Cape Sable eastward to the Grand Banks and northward to Cape Mercy, over the Denmark Strait and the northwestern portion of the Norwegian Sea, and over the southern portion of the North Sea. The frequency increases to more than 20 percent in the Resolution Island area and over the Norwegian Sea north of about 70°N.

NORTH PACIFIC, JANUARY

WEATHER. The most severe weather of the year occurs generally in January over the middle and northern latitudes of the North Pacific. The circulation over the ocean is controlled mainly by the major centers of action--the Aleutian Low, the subtropical High, and the Siberian High. All except the subtropical High are near or at their peak seasonal development. The Aleutian Low, with a central pressure of 1000 mb, is southeast of Kamchatka near 50°N, 165°E, while the axis of the Pacific subtropical ridge exceeds 1021 mb from about 30°N, 135°W, east-northeastward to the State of Wyoming. The wind regime near the Asiatic coast from the Korea Peninsula to the South China Sea is controlled principally by the clockwise flow around the Siberian High (1036 mb), situated over Asia near 49°N, 96°E.

WINDS. Westerly winds prevail over much of the ocean north of 30°N and west of 180°. Northerly winds dominate the East China Sea. Winds are variable over the western Aleutians, southeasterly over the central Aleutians, and northeasterly near the Pribilof Islands. From the Gulf of Alaska southward to near 40°N and east of 180°, winds are mostly westerly to southerly, although other directions are common during the frequent passage of LOWs. Over the extreme northern Gulf of Alaska, the prevailing winds are easterly, and northerly winds are very pronounced over the Bering Sea north of 60°N. The average speed of winds north of 30°N is force 4 to 6, although southeast of Kamchatka the wind blows at force 7, 21 percent of the time. The "northeast trades" extend northward to near 25°N over most of the western and central ocean and to 30°N over eastern waters; south of 20°N, these winds are very steady. The wind speeds in the trades range from force 3 to 5. The "northeast monsoon" is steady over the South China Sea and the Philippine Sea south of 30°N and west of 150°E. Winds are quite variable over the eastern North Pacific between 30° and 40°N, southwesterly over the east-central ocean between 25° and 40°N, and variable over west-central waters between 25° and 30°N and 150°E and 180°. Wind speeds over the above three areas are usually force 4. Northerly winds predominate over the Gulf of Tehuantepec, and in 65 percent of the observations they range between force 2 and 6.

GALES. The frequency of gales near and above 10 percent affects most noncoastal areas south of the Aleutians and north of a line from the waters southeast of Honshu to a point south of the Queen Charlotte Islands and west of Washington State. A maximum incidence of over 20 percent is found over a relatively large region southeast of Kamchatka, over a smaller area east of northern Honshu near 39°N, 154°E, and south of the Gulf of Alaska near 50°N, 145°W. Gale-force northerly winds are encountered more than 10 percent of the time by vessels plying the Gulf of Tehuantepec off southern Mexico. These violent squally winds occur when strong northers from the Gulf of Mexico funnel across the isthmus to the Pacific. In extreme cases, they may be felt more than 200 mi out at sea.

EXTRATROPICAL CYCLONES. Principal areas of cyclogenesis during winter are found from Taiwan on the southwest to the northern Kurils and lower Sakhalin on the northeast and from just north of Marcus Island on the southeast to the western shore of the Sea of Japan on the northwest. The Yellow Sea and Korean coastal waters are not included in this vast region of cyclogenesis. Other smaller areas of cyclogenesis lie over the Pribilof Islands, the Gulf of Alaska, off the North American coast from the Queen Charlotte

Islands southward to northern California, and over the east-central ocean about midway between the Aleutian and the Hawaiian Islands. The migratory LOWs move mostly northeastward from the East China Sea and Hokkaido to the western Aleutians and then east-northeastward to the Gulf of Alaska. Other primary tracks approach the Gulf of Alaska and Vancouver Island from the southwest.

TROPICAL STORMS are infrequent in January. On the average, two can be expected every 5 yr over the western North Pacific. Most of these storms develop between 6° and 10°N and west of 150°E and move toward the southern half of the Philippines. Three out of every five January tropical storms achieve typhoon strength.

SEA HEIGHTS greater than 12 ft occur more than 10 percent of the time in an area extending northward from 30° to 35°N to a line drawn from Kodiak Island to the central Aleutians and then to the southeastern waters of the Sea of Okhotsk, and westward from a line 700 mi off the coast of southeastern Alaska and 500 mi off the Oregon coast to 150°E.

VISIBILITY less than 2 mi occurs in 10 percent or more of the observations over an area of the eastern North Pacific between 40° and 50°N and 141° and 162°W, and northwest of a line drawn from Hokkaido to the western Aleutians and then northeastward along the Aleutian chain to the Alaska Peninsula and Cape Avinof. A maximum frequency of over 30 percent encloses a small area over the Okhotsk Basin southwest of Kamchatka.

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ADDRESSES OF NATIONAL WEATHER SERVICE PORT METEOROLOGICAL OFFICES

NOAA National Weather Service Port Meteorological Offices have personnel who visit ships in port to check and calibrate barometers and other meteorological instruments. In addition, port meteorologists assist masters and mates with problems regarding weather observations, preparation of weather maps, and forecasts. Meteorological manuals, forms, and some instruments are also provided.

ATLANTIC AREA

Mr. Robert Baskerville
Mr. Charles Schlott
Port Meteorological Officer
National Weather Service, NOAA
30 Rockefeller Plaza
New York, NY 10020
212-399-5569

Mr. William Gribble
Port Meteorological Officer
Atlantic Marine Center
National Weather Service, NOAA
439 West York Street
Norfolk, VA 23510
804-441-6326

GULF AREA

Mr. David Shawley
Port Meteorological Officer
National Weather Service, NOAA
701 Loyola Avenue
New Orleans, LA 70113
504-589-2669

Mr. Walter Sitarz
Port Meteorological Officer
National Weather Service, NOAA
1600 Port B'lvd
Miami, FL 33132
305-358-6027

Mr. Julius Soileau
Port Meteorological Officer
National Weather Service, NOAA
Route 6, Box 1048
Alvin, TX 77511
713-228-2527

Mr. Peter Connors
Port Meteorological Officer
National Weather Service, NOAA
P. O. Box 1306
Nederland, TX 77627
713-722-1152

GREAT LAKES AREA

Mr. William Kennedy
Port Meteorological Officer
National Weather Service, NOAA
Cleveland Hopkins International Airport
Cleveland, OH 44135
216-267-0069

Mr. Fred Day
Port Meteorological Officer
National Weather Service, NOAA
City-County Airport
Sault Ste. Marie, MI 49783
906-632-8921

PACIFIC AREA

Port Meteorological Officer
National Weather Service, NOAA
Metro Oakland International Airport
P. O. Box 6249
Oakland, CA 94614
415-273-6257

Mr. Anthony E. Rippo
Port Meteorological Officer
National Weather Service, NOAA
2005 T Custom House
300 South Ferry Street
Terminal Island, CA 90731
213-548-2539

Mr. Donald Olson
Port Meteorological Officer
National Weather Service, NOAA
Lake Union Building, Room 728
1700 Westlake Avenue North
Seattle, WA 98109
206-442-5447

PANAMA CANAL

Mr. Robert Melrose
Port Meteorological Officer
National Weather Service, NOAA
Box 1301
APO Miami 34005
(Local: Ft. Davis, Republic of Panama)
43-1565

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Battered hulk driven ashore by the mighty winds of hurricane Frederic in Mobile, Ala. For a description of Frederic see Rough Log, North Atlantic on page 426. Photo courtesy of National Ocean Survey.

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